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RAILWAY MECHANICAL ENGINEER

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RAILWAY MECHANICAL ENGINEER

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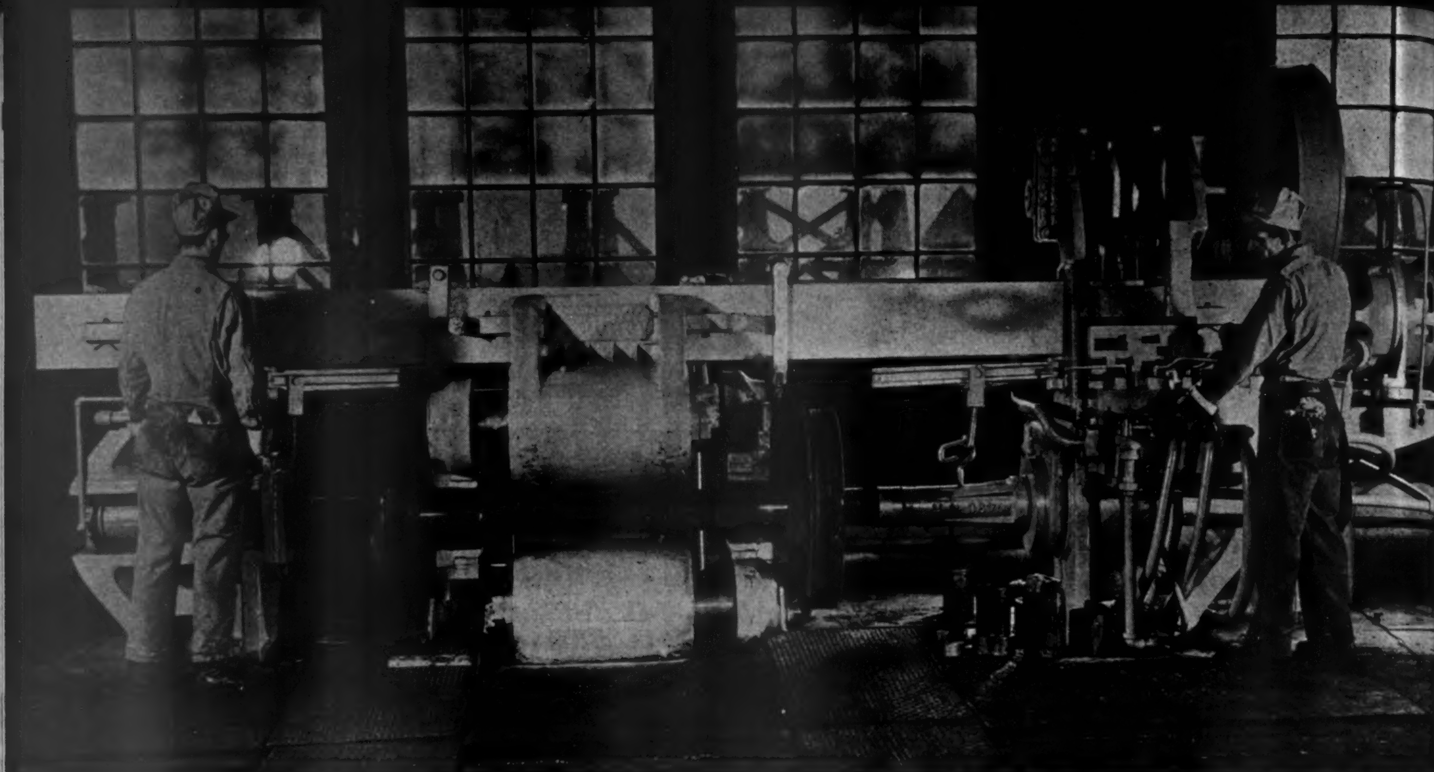

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STRIPPING TWO DIESEL WHEELS AND GEAR SIMULTANEOUSLY AT N. Y. O. & W. SHOPS, MIDDLETOWN, N.

An Opportunity Realized

Each year, in advance of the annual meetings of the Coordinated Mechanical Associations, the *Railway Mechanical Engineer* has expressed the belief that these meetings offer the railways and their mechanical supervisors a rare opportunity for expediting improvements in practice, and for an access of inspiration, the benefits of which, to the individuals as well as to the employing companies, are immediate and continuing in their effects. This year the problems created by the 40-hour week, which became effective in the very month in which the meetings were held, seemed to magnify the value of this opportunity.

As has been true for several years past, the hopes of those who planned and conducted the meetings were realized. The fears that the pressure of the immediate adjustments necessitated by the 40-hour week and the coal strike which began simultaneously with the meetings might keep many men at home who had intended to attend were not realized. Registration of railroad men was not unfavorable in any case when compared with that of the previous year; in most cases it was larger. Territorially, the entire United States and Canada were well represented. The high quality of the programs will be evident to the reader of this issue, in the editorial pages of which will be found the proceedings of five mechanical and two electrical associations whose meetings were held at two Chicago hotels beginning September 19.

Space is not available for an appraisal in detail of the work of each of the associations. Not all of the matters presented and discussed at the various meetings were new; there was some replowing of old ground. But that does not imply any waste of time. There are always men in attendance to whom the subjects are new and discussions always bring to light new aspects of practice or administration which contribute no small part to the sum total of the help the men in attendance find it possible to get out of these meetings.

In the meetings which have to do with locomotive operation and maintenance the interest in the subjects pertaining to Diesel motive power was striking. This was evident both in the greater attendance as well as in the amount of discussion when Diesel subjects were under consideration. The value of the steam papers, however, must not be discounted. Take the subject of better coal for steam locomotives, for example. While progress in arousing the railroads to an interest in it has been slow, the effect of the papers and reports presented before the Railway Fuel and Traveling Engineers' Association over recent years is beginning to show. It would be a distinct loss to the railroads if it were to be dropped from future programs.

A wholesome tendency toward closer co-ordination of the work of these bodies received a boost during the meetings this year. The Railway Fuel and Traveling Engineers' Association and the Air Brake Association met in joint session for the discussion of the two train-handling reports of the former body and to listen to a forward-looking address by L. K. Sillcox which dealt, among other things, on future train braking. The Electrical Section, Mechanical Division, A.A.R., and the Locomotive Maintenance Officers' Association, joined forces for the discussion of electrical maintenance of Diesel-electric locomotives, an arrangement which will probably be continued.

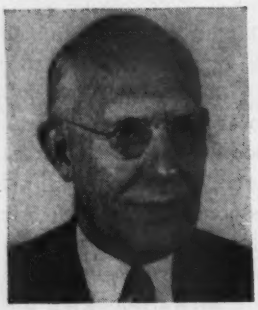
There is also evidence of closer co-operation between the two electrical sections which conceivably could result in a merger. The problem will be to take care of all the widely scattered needs of electrical association work and at the same time hold the work together in such a way as to retain necessary unity.

A noticeable feature of the exhibit of the Allied Railway Supply Association was the number of displays of products for use on Diesel locomotives or for use in their maintenance. Nearly one-quarter of the exhibitors devoted at least some of their space to such exhibits.

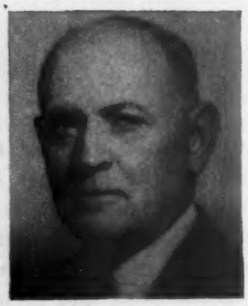
Considering all of the meetings together, the 1949 record of the Co-ordinated Mechanical Associations is one marking the continued success of these organizations individually as well as in the collective aspects of their activities. Several hundred supervisors have now returned to their jobs where the inspiration from their contacts with others whose duties are like their own are now being revealed in the renewed energy with which they are tackling their daily problems, and suggestions for improvements in practice which came out of the meetings are bearing fruit in the working out of more effective ways of doing many kinds of jobs.

Joint Session Hears About Fuel

Dr. Kettering discusses the potentialities of fuel supply for Diesels from sources as yet undeveloped



C. F. Kettering



E. H. Davidson

On Monday, September 19, the Coordinated Mechanical Associations—the Air Brake, Car Department Officers', Locomotive Maintenance Officers', Master Boiler Makers' and Railway Fuel and Traveling Engineers' Associations—opened the 1949 annual meeting at the Hotel Sherman, Chicago, with a joint session. On this opening day, the registration was approximately 2,100 railroad men, supply representatives and guests out of a final total of 3,011.

The meeting was presided over by A. K. Galloway, general superintendent motive power and equipment of the Baltimore & Ohio, who is chairman of the Coordinated Railroad Associations. The principal speakers at this joint session were Charles F. Kettering, retired vice-president of General Motors Corporation, who was introduced by C. R. Osborn, general manager of the Electro-Motive Division of General Motors, and Edward H. Davidson, director of the Bureau of Locomotive Inspection, Interstate Commerce Commission, who was introduced by John M. Hall, retired director of the bureau. J. E. Goodwin, vice-president and executive assistant to the president of the Chicago & North Western, spoke briefly on the work of the associations and the opportunity that railroad association members have under present conditions to contribute to substantial economies in operating expenses by developing the ways and means to eliminate the time-and-a-half that is now being paid on many jobs.

Kettering Optimistic About Fuel Supply

Dr. Kettering expressed the opinion that industry has not done too good a job in getting across to the public that great organizations like the railway industry don't "get their stuff" by just pressing a button. They have been accepted as being there for so long that "we have lost the economic significance of what the railroads have done for the country," he said. "We have lost the significance of the first transcontinental railroad; they tied together a political situation which determined the entire future, at that time, of our United States." Someone, he said, ought to write a story that would look backward on the American railroads, as to what they have meant to this country in bringing it up to the present time. When people in the business write these things, he added, they are written from the inside, and the writers know so much about it that they leave out what they think everybody knows, and which few outside the industry appreciate.

Mr. Kettering raised the question of fuel for internal combustion engines and said that the idea is brought forward periodically that the nation is just on the verge of running out of fuel. First, he declared, we have to try to find out what we mean by fuel. He showed charts of the production of power and the amounts of fuel consumed by the various types of power users, such as manufacturing, automobiles and railroads, and finally charts of the estimated reserves. He discussed briefly the development of the procurement of oil from shale and indicating the future possibilities mentioned the research work of the Bureau of Mines at Rifle, Colo., where in one location "there is enough fuel to equal six times the amount we have used in the 90 years that we have been using oil. I'm giving you that because sometimes I think we begin to worry too much, and to introduce into our calculations factors which are unessential."

As an indication of the possibilities of "raising" fuel Mr. Kettering pointed out that the sun is the source of all energy and that as long as the sun shines we don't need to worry. "The only thing we have that the sun works with is the leaf of the plant, yet we catch a lot of energy. We have a very large corn crop today, and you can get enough power from an acre of corn—if we have the proper way of transforming it into fuel—to run the average automobile about a year."

Speaking of automobile fuel the speaker remarked that

an automobile uses about its own weight per year in fuel and that it would take about 80 million acres of ground to provide the fuel for 40 million automobiles, if we had the process, but, not having the process we fall back on the fact that Nature has stored up in the ground this enormous amount of fuel. These examples were used to show that in estimating the future fuel supply allowance must be made for inventive genius that will undoubtedly find the way to new kinds of fuel long before present types are depleted.

In concluding Mr. Kettering said that "so far as our ability to make things, to raise things, to fabricate and to transport things goes, no nation in the world has the opportunities that we have here. And so, if we can just think of the tremendous job that has been done in building this country; of the almost unbelievable job that the American railway system has done in bringing the United States to its present position, we should have nothing to fear and everything to hope for."

Davidson Discusses Maintenance Standards

It is significant that safety, dependability, staying power and economy are characteristics of locomotives that improve or decrease as the physical condition of locomotives changes for better or worse. It is generally accepted that a safe locomotive is a well-maintained locomotive. Locomotives that have been thoroughly and adequately repaired and properly maintained between shoppings are durable and economical and the service per maintenance dollar is greater than for locomotives receiving only indifferent and makeshift attention. Intensity of use and the training and experience of maintenance personnel have a direct effect upon the accident and casualty rate.

The difficulties encountered in maintaining steam locomotives in condition to meet traffic requirements during the war years are a painful memory in the minds of mechanical men. The effect of material shortages, an inadequate number of experienced mechanical personnel, and a high use factor are reflected in comparative steam locomotive accident figures for the five-year periods ended June 30, 1941 and 1948 respectively. In the latter period accidents per thousand locomotives for which inspection reports were filed increased 130 per cent, fatalities nearly 17 per cent and injuries 125 per cent over the five years ended in 1941. It is significant that during the five years ended December 31, 1947, only 1,033 new steam locomotives were built for the Class I railways. Thus, increased age, in addition to the other factors, results in an adverse effect upon the accident rate.

The transition from war to peace-time economy has had a profound effect on the motive power situation in this country. A large number of old and decrepit locomotives are now retired or awaiting retirement. Efforts are under way on many railroads whereby the practice of substantial and lasting repairs, including some betterments, is the order of the day for those locomotives whose design and age indicate considerable prospective future usefulness.

We are also witnessing a change in the motive power situation as a result of the introduction of the Diesel-electric type of locomotive in all kinds of service, switching, passenger and freight. The extent of total replacement of steam locomotives by Diesel-electric is not yet determinable. It will undoubtedly reach a stage of equilibrium after factors of initial cost, fuel supply, maintenance costs, service life, etc., have become a matter of operating record.

The Diesel-electric locomotive is, by its nature, more nearly a precision type of machine in many details than the steam locomotive. Tolerances in injectors, fuel pumps, valve mechanisms, bearings, cylinder and liner details are very small. Electrical equipment, including relays of various types, also requires a high standard of maintenance if satisfactory operation is to be had. Cleanliness is a prime requisite to successful Diesel operation. A small accumulation of dirt in a critical location can be the course of irregular functioning of a unit or may be the cause of an engine failure. We all know that defects are more easily seen and corrected in a well policed unit than in one covered with oil and dirt.

I shall not attempt a detailed discussion of Diesel maintenance because most of you are familiar either by association with, inspection of, or through trade literature, of the modern facilities installed on a number of railroads to service and maintain Diesel-electric units. Many of the facilities resemble laboratories more than the engine terminals with which we grew up and the standards are correspondingly exact.

In any mechanical device there are usually certain places which are potential sources of trouble and to which additional attention should be given. Such is the case with Diesel locomotives as well as steam locomotives. When these trouble spots are recognized through experience and indicated inspections and repairs are properly made operating difficulties and accidents will be avoided.

There are two types of accidents with which we have had experience upon which I might comment. The first type is crank case explosions. Fundamentally these accidents are caused by an accumulation of fuel oil in the engine base which through agitation can cause formation of an explosive mixture of vapor in the base. If a localized hot spot develops because of lubrication difficulties or other cause a more or less severe explosion will occur. Proper inspection and maintenance including careful periodic testing of samples of lubricating oil from engine bases should avoid many accidents of this character. The second type involves traction motors and their bearings. Three serious accidents from this source have occurred since January 1 of this year. In two instances the failure of armature bearings resulted in locked pinions which caused the wheels to slide and ultimately resulted in derailments. In the third case the failure of a suspension bearing caused a broken axle and subsequent derailment. These traction motor bearings are in relatively inaccessible locations on all units and for that reason should be examined carefully at each inspection by dependable men of adequate experience and training in order that every precaution may be taken to prevent failures and accidents on line of road.

I presume that many of you have acquired considerable experience with Diesel operating characteristics and following tthe custom of railroad men will share this knowledge with newcomers in the field. Much good can come from meetings of this kind and we usually return with an increased store of information and the realization that the other fellow has his troubles also.

We have a great common interest in the cause of safety and by teamwork we should advance continuously. With this thought in mind, and your appreciation that we, of the Bureau of Locomotive Inspection, have a specific duty to perform, I hope you will welcome our inspectors at your various terminals, not as critics of your work, but as men dedicated to the cause of safety who are required to see that certain standards of maintenance are met and who will, as far as possible consistent with their duty, pass along such of their experience as may be of assistance in solving problems of the moment.

L. M. O. A. Considers Modern Maintenance Techniques

J. W. Hawthorne, President
(Assistant chief motive power and equipment, A. C. L.)

Eight technical reports and two addresses cover a variety of subjects on steam and Diesel repair work

THIS year, again, the Locomotive Maintenance Officers' Association had the largest registration—644 members and guests—of any of the groups forming the Coordinated Railroad Mechanical Associations at the September 19 to 22 meeting at the Hotel Sherman, Chicago.

During the four-day meeting this association listened to the presentation of eight technical committee reports on the subjects of engine terminal facilities for both steam and Diesel power; shop tools and devices for simplifying repair operations on both steam and Diesel repair work; expediting systems for both shop and enginehouse; personnel training; maintenance of electrical equipment of Diesel-electric locomotives and the maintenance of mechanical equipment on Diesel-electric locomotives. All of these reports dealt with the respective subjects in considerable detail and because of their length those reports on steam engine terminal facilities, shop expediting systems, shop tools and Diesel electrical maintenance have not been included in the report of the meeting appearing in this issue.

In spite of the fact that the program was again predominantly Diesel there was considerable emphasis placed on the fact that the major portion of the motive power inventory of American railroads is still steam power and that not enough attention is being given at present to its mainenance. This thought was reflected in the address of J. W. Hawthorne, president of L. M. O. A. in his remarks at the session on Monday, September 19, in which he said, in part:

"Until recent years, the regular line of promotion for railroad mechanical men came through apprenticeships, the shops, roundhouses, backshops, and so forth. Due to the rapid introduction of Diesel-electric locomotives and the revolutionary changes in passenger car design, an entirely new group of supervisors and even top management is appearing on railroads over the country, with many of these men being drawn from the ranks of electrical supervisors, Diesel supervisors and often carmen. In their anxiety to turn in a good performance, it is obvious that entirely too much attention is paid to some of the new devices and new forms of motive power to the detriment of freight cars and steam locomotives.

G. E. Bennett, First Vice-Pres.
(Superintendent motive power, C. & E. I.)

P. H. Verd, Second Vice-Pres.
(Superintendent motive power and equipment, E. J. & E.)

H. H. Magill, Third Vice-Pres.
(Superintendent locomotive and car shops, C. & N. W.)

C. M. Lipscomb, Sec.-Treas.
(Assistant to schedule supervisor, M. P.)

"In addition to this, an entirely new economic situation is confronting railroad management—that is, the economics of getting the most out of each dollar invested in steam power during the transition period from steam to Diesel power.

"I wish to caution all of you and emphasize the fact that if railroad mechanical officers fail to take full cognizance of the proper position of steam power on the average railroad, that many of the fine records and splendid performances thus far turned in by energetic mechanical departments are going to suffer. Top mechanical managements must go through this transition period by taking full advantage of the economics of the situation, or be replaced by management which will handle the situation economically."

Mr. Hawthorne also cautioned the locomotive officers that substantial losses might conceivably occur if judgment is not used in withdrawing from service steam power that is due to be replaced by new Diesel power; in this connection he said, in part, that "we cannot afford to spend huge sums on steam power which will soon be displaced by Diesel locomotives, neither can we afford to scrap steam locomotives still having unused and serviceable mileage. At an average of between 35 and 50 cents per mile of operation in direct maintenance cost, you can readily see the losses sustained by a railroad when steam locomotives are set aside for retirement with any appreciable amount of unused mileage left in them.

"It is up to Diesel men to become better acquainted with the problems in the steam locomotive field if they expect to be advanced into top management or hold this advancement once it is offered them. No performance, regardless of its excellence, would be sufficient to overshadow the economic loss that would result if steam power is not worked out of the motive power picture by mechanical officers who literally squeeze the last mile of operation out of each locomotive, safely and economically.

"When a steam locomotive is outshopped after classified repairs, it represents an investment of from 5,000 to 30,000 dollars (depending on the type and class of repairs) on the part of the management, and this investment must be profitable. To make it so is the job of the mechanical department, through wise shopping schedules and constant study of assignments, running repairs and costs."

At Tuesday morning's session the importance of steam power was also emphasized in an address by A. K. Galloway, general superintendent motive power and equipment, Baltimore & Ohio, in which he called attention to the fact that steam power still handles the largest part of the nation's rail traffic and that because of the significance of this subject he had been requested to discuss the maintenance of locomotives, with particular reference to steam, before the association, "because of the apparent general opinion that due to the rapid replacement of steam locomotives by Diesel, the discussion of proper maintenance of steam locomotives was being neglected. Since that time," said Mr. Galloway, "the present director of the I. C. C. Bureau of Locomotives Inspection, called my attention to the fact that in a number of recent serious accidents on the railroads, their investigation developed the primary cause was defective conditions resulting from neglected maintenance of steam locomotives." The remainder of Mr. Galloway's address was taken up with detail suggestions as to the proper manner of maintaining locomotives and concluded with the thought that "we should also be alert to other types of motive power equipment that is being tested or developed in the interest of economy in operation and maintenance and their progress should be closely followed. Various types of motive power, including the modern steam locomotive, have contributed greatly to the progress of American railroads and there is no doubt but what progress in motive power will continue to improve operations on the railroads in the future."

The following officers and board members were elected to serve for the year ending in September, 1950: President, G. E. Bennett, superintendent motive power, Chicago & Eastern Illinois; first vice-president, P. H. Verd, superintendent motive power and equipment, Elgin, Joliet & Eastern; second vice-president, H. H. Magill, superintendent locomotive and car shops, Chicago & North Western; third vice-president, S. M. Houston, assistant general superintendent motive power, Southern Pacific Co.; fourth vice-president, F. D. Sineath, assistant to chief of motive power and equipment, Atlantic Coast Line; secretary-treasurer, C. M. Lipscomb, assistant to schedule supervisor, Missouri Pacific.

Executive Committee (for one year): A. E. Rice, chief mechanical officer, Denver & Rio Grande Western; F. R. Denney, assistant mechanical superintendent, Texas & Pacific; T. T. Blickle, executive assistant-mechanical, Atchison, Topeka & Santa Fe.

Advisory Board: J. D. Loftis, chief of motive power and equipment, Atlantic Coast Line; D. S. Neuhart, general superintendent of power and machinery, Union Pacific; A. K. Galloway, general superintendent motive power and equipment, Baltimore & Ohio; L. R. Christy, chief mechanical officer, Missouri Pacific; A. G. Kann, general superintendent equipment, Illinois Central; F. K. Mitchell, manager-equipment, New York Central System; E. R. Battley, chief of motive power and car equipment, Canadian National.

* * *

REGISTRATION—COORDINATED MECHANICAL MEETINGS

Association	No. Registered*
Air Brake	229
Master Boiler Makers	258
Car Department Officers	449
Fuel and Traveling Engineers	238
Locomotive Maintenance Officers	644
Allied Railway Supply	1,038
Non-member guests	155
Total	3,011

* These totals include both members and guests.

Results of Dynamic Brake Tests

By J. P. Morris,

Assistant to vice president, Achison, Topeka & Santa Fe

J. P. Morris

In January and February of 1940 the first Diesel freight locomotive, EMD Demonstrator No. 103, was tested in main line freight service on the Santa Fe. Results of these tests were sufficiently promising that orders were placed for such locomotives. From the beginning, certain officers in both the operating and mechanical department of the Santa Fe visualized the possibilities of incorporating in the design of the locomotive a dynamic, or electric, brake for the control of trains on major descending grades.

The original dynamic brake was applied to Santa Fe Diesel Locomotive No. 100, delivered in December, 1940, the first Diesel locomotive, other than the demonstrator, in freight service on American railroads. It was also applied to four locomotives, Nos. 101 to 104, delivered later. This was a two-stage brake with limited functions. It had two operating positions at the controller and it was necessary to reduce speed by use of the air brake to a definite point before application of the electric brake.

This brake was not a stopping brake, and could be considered only as a holding brake with limited functions.

The major accomplishments of the original brake may be summarized as follows:

1.—Reduction in wear of wheels and brake shoes on heavy grades. By actual test, it was found that the dynamic brake absorbed from 25 to 50 per cent of the energy formerly required of the air brakes to control the speed of a train on heavy descending grades.

2.—As result of the above, certain stops made primarily for cooling wheels and brake shoes were eliminated.

3.—A total saving of time for trains on the mountain grades between Winslow, Ariz., and San Bernardino, Calif., of one hour in either direction was made possible by the elimination of stops to cool wheels, and by closer control of speeds.

While the results obtained from the early dynamic brake were encouraging, the mechanical department of the Santa Fe was not satisfied that the ultimate had been reached, and asked for the further development of a multi-stage brake.

In October 1941 the Electro-Motive Division of General Motors offered the perfected multi-stage brake suitable for all operating grade conditions and with an operating speed range of from 10 to 60 m.p.h. in freight service.

The first Santa Fe locomotive to have this brake applied was Locomotive No. 105 in service in March 1942. It was also applied to all other locomotives delivered since; both freight and passenger. In addition, the earlier two-stage brakes in Locomotives Nos. 100 to 104 were replaced with the multi-stage brake.

Comparative results from the use of the brake with the earlier two-stage brake are as follows:

These data are based on test performance of the various locomotives on mountain grades between Winslow and San Bernardino. On runs with Diesel Locomotive EMD 103, air brakes were applied on the train 50 per cent of the running time on the major descending grades both westbound and eastbound. In other words, over a distance of 460 miles of mountain grade territory, of which 250 miles is descending westward and 210 miles descending eastward; it was found that train air brakes were actually applied for a distance of approximately 125 miles westward and 100 miles eastbound.

The two-stage brake, as applied to Locomotive 100 to 104, was effective on approximately 60 miles of heavy grade westbound, and on about 35 miles of the eastbound grade. It was necessary to supplement this earlier brake on these same grades about one-third of the distance westbound, and about one-half of the distance eastbound where the dynamic brake was used.

The multi-stage brake later applied was used effectively on all descending grades for a distance of 185 miles westbound and 130 miles eastbound.

It should be noted that with the use of the dynamic brake the air brake applications in conjunction with the use of the electric brake were at considerably lower brake cylinder pressures than when air brakes only were used.

There was some difficulty with grids and with blower motors for cooling these, apparently from lack of capacity. This was overcome by rewinding the blower motor armatures.

The result from the use of the dynamic brake is reflected in the record of slid flat wheels and brake burned wheels. A comparison of the statistics on these items showed a startling reduction in both slid flat and brake burned wheels.

TABLE I—COMPARISON OF BRAKE OPERATING DATA

	Six-year period 1937-1942, before dynamic braking	Six-year period 1943-1948, after dynamic braking
Miles per pair of slid flat wheels:		
Freight	1,838,983	3,029,611
Passenger*	954,019	1,164,763
Miles per brake-burned wheel	88,542	422,173

* Only a limited number of passenger Diesel locomotives were equipped with dynamic brakes prior to 1947.

TABLE II—COMPARISON OF BRAKE SHOE WEAR

		Brake shoe wear—lb. per round trip: Air brake only	Dynamic plus air brakes	Reduction
150 per cent braking ratio:				
Series A:	Train	1930.3	1238.3	692.0
	Loco	1001.6	136.4	865.2
	Total	2931.9	1374.7	1557.2
Series B:	Train	1580.1	653.2	926.9
	Loco	578.8	210.1	368.7
	Total	2158.9	863.3	1295.6
Series C:	Train	1557.1	458.0	1099.1
	Loco	496.6	69.5	427.1
	Total	2053.7	527.5	1526.2
Series D:	Train	1789.9	559.9	1230.0
	Loco	609.4	33.5	575.9
	Total	2399.3	593.4	1805.9
Series E:	Train	1478.9	480.0	998.9
	Loco	522.0	38.8	483.2
	Total	2000.9	518.8	1482.1
Avg. All Series:	Train	1667.3	677.9	989.4
	Loco	641.7	97.7	544.0
	Total	2309.0	775.6	1533.4
250 per cent braking ratio, speed-governor control:				
Series A:	Train	2904.2	1203.8	1700.4
	Loco	728.7	114.5	614.2
	Total	3632.9	1318.3	2314.6
Series B:	Train	2290.7	808.3	1482.4
	Loco	629.9	53.8	576.1
	Total	2920.6	862.1	2058.5
Series C:	Train	1889.0	588.1	1300.9
	Loco	548.4	48.2	500.2
	Total	2437.4	636.3	1801.1
Series D:	Train	1829.0	647.8	1181.2
	Loco	566.0	46.5	519.5
	Total	2395.0	694.3	1700.7
Series E:	Train	1979.2	501.6	1477.6
	Loco	480.7	42.2	438.5
	Total	2459.9	543.8	1916.1
Avg. All Series:	Train	2178.4	749.9	1428.5
	Loco	590.7	61.0	529.7
	Total	2769.1	810.9	1958.2

TABLE III—AVERAGE BRAKE SHOE WEAR

	Brake shoe wear—lb. per round trip		
	Air brake only	Dynamic plus air brake	Reduction
Train	1922.9	713.9	1209.0
Loco	616.2	79.4	536.8
Total	2539.1	793.3	1745.8

TABLE IV—REDUCTION IN BRAKE SHOE WEAR

Territory	Grade condition	Reduction in brake shoe wear by use of dynamic brake to full extent, per cent
Eastern lines	Level to light, generally not over 0.8 per cent	14.0
Gulf lines	Level to medium, maximum grades 1.25 per cent	32.0
Coast lines	Medium to heavy grades, 0.6 to 3.0 per cent	66.0

Table I, covering two six-year periods before and after the inauguration of the use of the dynamic brake, illustrates the difference.

As a result of experience gained with the use of the dynamic brake in heavy grade territory the Santa Fe undertook extention of its use for control of train speeds in all territories; both on level and on descending grades.

Beginning in the fall of 1948, and extending to May 1949, a series of road braking tests of high speed passenger trains was made, and, in order to get complete information, a dynamometer car was used to record data from which information could be developed to determine whether the use of the dynamic brake in level territory would produce savings commensurate with those obtained from use on mountain grades.

A series of test runs was made using 150 per cent braking ratio on passenger cars without high-speed governor control. All tests were made on our El Capitan light weight, streamlined, all-coach train between Chicago and Los Angeles, operating on a schedule of 39 hr. 45 min. for 2,227-mile run. Each series of test runs consisted on one round trip with each braking ratio using air brakes only and one round trip using the dynamic brake to the fullest extent, and supplementing with the air brake when necessary. Five series of test runs were made using different types and sizes of brake shoes.

The detailed data from these tests, which involves some 90,000 miles of road testing, are in process of analysis, but have not progressed sufficiently to evaluate the various types of brake shoes tested.

Table II shows the results accomplished by use of the dynamic brake in reducing brake shoe wear. All data have been equated to an average 13-car train.

As a result of the tests in passenger and freight service instructions were prepared. These have been issued as standard bulletined instructions, requiring that the use of the dynamic brake in both freight and passenger service be mandatory.

[This section of the report included the complete instructions for the use of the dynamic brake in the operation of various classes of Santa Fe locomotives—EDITOR]

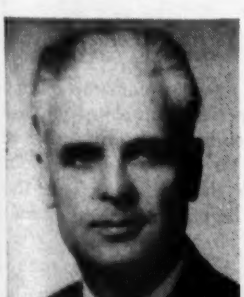
During test runs particular attention was given to the handling of trains for smoothness of operation. In general, there were few occasions of rough handling or shock due to slack action from the use of the dynamic brake.

The economic value of the dynamic brake has been fully demonstrated and it is expected that full use on level and light grade territory as well as on heavy grade territory will result in considerable saving in brake shoe and wheel wear, and a reduction, also, in thermal cracked wheels from overheating. With the use of the dynamic brake, supplemented by the air brake, it was demonstrated that trains could be decelerated quicker than by use of the air brake alone.

There has been a marked reduction in failure of brake beams and brake beam attachments, and delays incidental to changing worn or burned brake shoes have almost entirely disappeared.

The use of the dynamic brake to the fullest extent also gives greater reserve braking capacity since the air brake is complementary to it and is always available for use in conjunction with the dynamic brake.

The Training of Mechanical Personnel



J. Wolff, Chairman

Executive officers are faced with a major decision. How can they secure the wholehearted and intelligent cooperation of the employees and their unions so the railroads' customers will get maximum service at a competitive price? Without that cooperation, they cannot accomplish the radical improvement in efficiency and cost reduction required to retain their full share of the transportation business. Technological improvements and improved employer-employee cooperation must go together.

Policy Recommendations

The following policy recommendations are made for the purpose of increasing management effectiveness within the mechanical department:

1.—The chief mechanical officer should be held responsible without interference for operating within his budget. He should have and exercise full authority to arrange or rearrange his own officers, supervisors and employees in whatever manner will improve operations at lower costs.

2.—The company policy should clearly authorize the chief mechanical officer to organize his department so as to have the responsibility and authority of each officer and supervisor clearly defined in writing—but with full recognition of possible limitations because of agreements where supervisors are unionized. The administration of this program should be delegated to a qualified officer responsible directly to the chief mechanical officer for its successful operation.

3.—Company policy should indicate clearly that all officers and supervisors are to be kept promptly and fully informed on new policies and changes in existing policies; the railroads' economic and competitive situation; company and departmental plans, production plans; employee and labor relations problems; and such other information as will enable these supervisory employees to help their rank-and-file employees identify their own personal interests with the interests of the company. Information should be transmitted through supervisors so as to maintain their prestige.

4.—Company policy should direct that officers and supervisors are to be consulted in developing policies and plans which affect their employees and the production within their own departments.

5.—The company policy should be clear and explicit regarding the company's relationship with its employees and their unions. Each officer and supervisor should receive a clear understanding of the policy—including the wording, interpretations and the most recent decisions on agreement clauses as they affect the various localities, so they can administer those policies uniformly and fairly without discrimination.

6.—Management should establish a policy of compensating supervisors so as to insure fair pay differentials and income commensurate with responsibilities and authority.

This policy should call for a definite plan for supervisory recognition and advancement based on individual abilities and accomplishments. Supervisors should also be differentiated from rank-and-file employees by policies and practices which plainly recognize their management status.

Recommendations to Mechanical Management

The mechanical department has two choices with regard to personnel development programs:

Haphazard training or well-planned, adequate training; closely supervised by top officers; high employee morale, efficiency and reduced costs; normal training expenses.

One mechanical officer has suggested as a third choice that the department train its own men, or the unions take over the training.

A well-planned personnel development program requires (1) training in leadership and human relations to learn why people do the things they do so that officers and supervisors can become expert in stimulating employees so they will *want* to do their work well; (2) Administrative training to learn why the delegation of necessary responsibility and matching authority increases efficiency and what the penalties are when an officer or supervisor doesn't trust people enough to delegate the necessary responsibility and authority; (3) Technical training to know operations and practices in his own field and to learn advanced methods and improvements in equipment, tools and materials and (4) Economic training to learn how competition by other modes of transportation affects the welfare and security of the railroad and how this affects the welfare and security of the individual.

Supervisory development should be continuous. There is no such thing as completed training for supervisors. Management training must be kept up so long as officers and supervisors operate at less than maximum efficiency.

The program for employee training includes (1) technical training in craft or jobs; (2) continued training on new methods, equipment, tools and materials for mechanics and others who perform rank-and-file work; (3) economic training through supervisors and by other means on the competitive situation of the railroad to demonstrate how inefficiency and high costs lead to higher rates which drive away business and endanger the welfare and security of the employee and his family and (4) training for advancement by encouraging and helping employees prepare themselves for advancement.

The training program should also provide the means for helping supervisors and mechanics prepare themselves for full time or part time assignments as instructors. An instructor's job is a top training position because instructors always learn more than the people whom they instruct.

Training Time

Training should be on company time wherever the training will result in improved efficiency and cost reduction greater than the cost of training. Additional training should be provided for employees on their own time where this training is used to help them prepare themselves for advancement to higher positions. Whenever the higher positions must be filled at once to insure efficient operations, or where the company must prepare employees to work with new equipment—such as Diesels—it is usually to the advantage of the company to provide the necessary training at company expense and on company time.

Whenever employees are trained on company time, attendance can be required. Whenever employees are trained on their own time, attendance cannot be required but must be voluntary. Theoretically, the voluntary training is best; actually it frequently works out that training on company time is most productive for the company because it reaches a larger number—especially those individuals who need it the most—and the attendance is more regular.

Training Organization

A full time training organization should be established responsible to the chief mechanical officer. Where the railroad has a system-wide training organization, the mechanical department training organization should be responsible to the chief mechanical officer for *what* training is to be done and work closely with the system-wide training organization as to *how* that training should be done. But the final responsibility for the mechanical department training must remain with the chief mechanical officer.

The training organization should be part of the production organization with advancement from mechanical and administrative duties into the training department. After a period of training department experience, men should be eligible for advancement to higher line positions within the mechanical department. In this manner, training department experience becomes an effective training for higher responsibilities within the mechanical department. This procedure also insures sound and practical training for all mechanical department employees.

Fully qualified and widely experienced consultants with a record of successful accomplishments may be engaged to introduce a training program designed to fit the specific needs of a mechanical department and to assist in selecting and training capable officers and supervisors to take over and operate the program when it is well under way.

Evaluation of Training Procedures

Activities must be subject to constant evaluation to determine the extent to which they contribute to improved attiudes; whether they enable as well as stimulate each employee to do a better job which results in greater efficiency and decreased cost. If the program does not produce these results it means that it needs to be improved.

When the results of training are unsatisfactory top officers should discuss the problem with supervisors in charge of that particular work; find out what is holding back production or causing excessive cost; analyze why the operation is inefficient and develop the training approach that will overcome the problem. This solution should then be put into operation and checked continuously to see that it produces results.

Conclusion

The human element is by far the greatest single factor in the quality, quantity and cost of operations or production. No other items deserve as much time and effort on the part of the chief mechanical officer as do the attitudes, capabilities and accomplishments of officers, supervisors and rank-and-file employees.

The chief mechanical officer must work through his officers and supervision to improve the attitudes, capabilities and accomplishments of all employees. He cannot do it alone—even though he does devote a large part of his own time each day in training his officers and supervisors to train and influence all others toward a constant improvement in morale and efficiency.

Attitudes and morale are most important. Every employee must *want* to increase and improve his accomplishments because he has been helped to see that he benefits himself and

his family as well as his company. He must be helped to see that he needs to increase his capabilities in order to increase his accomplishments—and through those, his own welfare and security. He must be helped to develop the necessary self-confidence so he will step out and do the best possible job.

Capabilities are also important. Even though a man wants to do a good job, he must have the necessary qualifications before he can do it. He needs knowledge and skills—both mental and manual. He should be helped to learn so much about his own job that he will recognize how little he knows about it. Then he will want to learn more. With encouragement and guidance he will work hard and successfully at improving his capabilities.

Mental skills are more important than manual skills—because without them, a man will fail to use his manual skills to good advantage. He should be encouraged to work hard to become skillful in observing, analyzing and solving problems; to develop within himself a high degree of skill in alert, analytical and conclusive thinking. Sound judgment is another name for it.

But no matter how intelligent a man may be—or how sound his judgment, he will accomplish little more than what he is told to do unless he also develops ingenuity and initiative.

Here the chief mechanical officer faces another decision. Unless he gives his officers, supervisors and men the right to make a normal number of mistakes, they will quit using their ingenuity and initiative and will go back to doing no more than they are told to do. Alert management authorities are recognizing that along with the delegation of responsibility and authority must go the right to make some mistakes. Men should not be disciplined for mistakes of judgment that could easily have been made by others under the same circumstances. Instead, they should be encouraged to profit by their mistakes —because they can always learn more from things that have gone wrong than from things that have turned out right.

When such a policy has been established and has earned the confidence of officers, supervisors and other employees, those railroaders will do everything in their power to improve efficiency and reduce unit costs. The brains of top management will be multiplied many times.

The members of the committee were Jack Wolff (chairman) special representative, Chesapeake & Ohio; F. K. Mitchell, (vice-chairman) manager-equipment, New York Central; J. L. Carver, mechanical and research engineer, Illinois Central; T. H. Evans, chief mechanical officer, Missouri, Kansas & Texas; L. B. George, assistant chief of motive power and rolling stock, Canadian Pacific; A. G. Hoppe, general superintendent locomotives, Chicago, Milwaukee, St. Paul & Pacific; S. M. Houston, assistant general superintendent motive power, Southern Pacific; J. W. Moe, superintendent of apprentices, Chicago, Milwaukee, St. Paul & Pacific; T. C. Shortt, chief mechanical officer, Nickel Plate and C. A. White, superintendent motive power, Southern Division, Atlantic Coast Line.

Discussion

One member from a western road mentioned that in the newer activities such as Diesel maintenance and air conditioning the jobs were given to the younger men but since the seniority rule is now in force many of these younger men are no longer supervisors and the question was raised as to how to encourage the younger men to want to become supervisors in future years. One mechanical officer brought out the fact that if supervisors are organized there is not very much that can be done about seniority. He did express the opinion, however, that there is plenty of room today for the younger men in the Diesel field who have the ability. Another mechanical officer said that on his road it was a policy to consider qualifications and seniority together, that the older men were given an opportunity to learn the new jobs and if they don't it is the company's policy to try to convince them where they can be used.

Another member raised the question as to the value of visual aids in training men. It was pointed out that during the war visual aids were used extensively in the rapid training of men and that in the new railroad work today there is exceptional opportunity to use motion pictures and other visual aids in training men in safety work, the technical operations connected with the maintenance of Diesel-electric locomotives and in air conditioning maintenance.

A member from a Canadian road mentioned that in the selection of supervisors it was the policy to choose supervisory candidates from among the men who had received apprenticeship training with the company. He described at some length the system used on that road for training apprentices and keeping records. He mentioned the company policy with respect to the encouragement of apprentices who wish to go beyond the apprentice course and take university training in technical subjects as well as the plan for the special training of university graduates who enter railroad service.

Introducing Steam Personnel to the Diesel

With the advent of the Diesel-electric locomotive a problem with which the railroads were confronted was, "Who was to maintain the new equipment?" The answer was to train men now working for the roads. What is their attitude going to be when confronted with this complicated piece of mechanism? In most cases Diesel maintenance work will be handled by men who have previously worked on steam locomotives—mechanics, for example, who have not been too accustomed to think in terms of thousandths of inches, factory fits and adjusted parts. Consequently, most of these steam locomotive maintenance men resent the Diesel.

The Attitude Toward Instruction

To the machinist, it will first appear to be, "Let someone else do it." Previously it was felt that the Diesel was another "passing fancy," the same as other attempts to replace the steam engine, so why give up a good job on steam work and then when it is gone return to an inferior job on the steam work because someone else was on the good job.

These men know that calipers or a rule for measurements and sight and feel on pins and bushings will no longer be used. Micrometers and feeler gauges will be used instead. The heavy, crude and often inadequate tools used on steam locomotives will be eliminated and the torque wrench will replace the monkey wrench. The geared wrench will replace the buggy bar and barrel wrench. It means almost another apprenticeship to be served, which is greatly resented.

To the electrician, the advent of the Diesel-electric is not resented in near the light as it is to the machinist. With Diesel-electric locomotives, it means more work, more men, and much more exacting work, all of which are desirable.

It must be remembered that personnel as a whole resent the encroachment of the Diesel into their lives. To get their wholehearted support they must be enlightened and in-

formed of the reason for this change. If at all possible a course of instruction should be set up long before the first locomotive arrives. This sets the ground work so that all personnel receive the correct and true picture of what the Diesel will mean to them.

A preview of coming work is of utmost advantage to the company as a whole. It stimulates interest and arouses curiosity. It also creates the necessary good feeling among the supervision and the maintenance personnel that is conducive to greater production. When the maintenance personnel is enlightened on what is taking place they are made to feel as part of the organization.

Everyone interested should be urged to attend, from the lowest paid man to the last supervisor, including clerks and stenographers that will be handling correspondence, storeroom employees, who will be handling material, and others that may come in contact with the work in any capacity.

Although special classes should be arranged for the supervision, the supervisors should arrange to attend all regular classes. If this is not done, many different interpretations will be taken by the supervision and the personnel, consequently no standard conditions would be met. This statement does not mean to infer that the supervision may assume different ideas on the allowances that govern some piece of work. Each supervisor may be correct, but a standardization of operating allowances is needed.

The problem always arises—why should an electrician sit through a discussion on the mechanical end or vice-versa. It never has been a practice before. To approach this attitude, a convincing explanation can be given, showing how, with the intertwined equipment, an understanding of each other's work will make theirs easier.

Space is limited on a Diesel and two men cannot work in the same space. As an example, a machinist may have an engine open and be starting a job which will require three hours to complete and an electrician has a cleaning job on the main generator, which will require only a short time. Both jobs cannot be done at the same time as the dirt from the cleaning job would enter the open engine. it would best work out for the electrician with his short job to hold off on it until after the engine is closed due to the fact that the longer job should be given preference as it is the determining factor on out-of-service time. Problems to the inverse do exist and can be given. A thorough understanding of such problems creates a smooth operating organization.

The mechanics helpers should be in on the instruction as well, for as has been definitely proven, a good helper is a great asset to a good mechanic. Upgraded helpers are in need of instruction as they are usually on a special job by themselves which requires them to have a knowledge of the closely connected work.

At the first meeting, the outline of how many Diesels there are to be and approximately how rapidly they will arrive should be discussed and then how many men it will require to service these engines. In other words, put them at ease and do not leave anything to supposition. The worst outlook will be taken otherwise, which will undermine the organization. If labor agreements do not hinder, arrangements should be voiced regarding rotation of personnel. This will give all men the opportunity to find the type of work for which they are best adapted.

The schedule of the instruction program should be outlined and a library of text books is to be set up for their use at the classes as well as at home.

On following meetings, the constructional details should be gone into with a definite example as to where they should go to obtain the correct limitations or tolerances. These classes are made up of all types of workers and infinite details would cause the loss of the attention of the whole class.

A review of basic electricity must be given. A definite course of blueprint and wiring diagram reading should be gone into. If the men are to be able to troubleshoot they must know how to read the wiring diagrams and the blueprints.

Classes on use of electrical indicating instruments should be arranged and the purpose for which they are used.

As the instruction program progresses, the work involved in Monthly inspections, Quarterly inspections, Semi-Annual and Annual work must be discussed in advance of the actual work.

Some inducement must be used to keep interest aroused. The easiest way to do this is to have the instructor given plenty of time to arrange the classes so that they may be given a minimum amount of delays and boring interludes. If the classes once lose interest, it is very difficult to again gain it back. In other words, the class must be presented so that it is an interesting experience, instead of a chore. When presented properly, a class can impart knowledge with almost an entertaining manner.

The use of visual aids is extremely desirable. Not only does it break the monotony of a sing-song lecture but it can and does present explanations in a few minutes, more clearly and thoroughly than several hours of lecturing.

Another great boon is that questions which may be asked are attacked and answered before the routine of the class presentation is broken by the question. A well informed instructor can do this.

Who Shall Instruct?

Usually one of the supervisors is picked for this job, but remember, a good supervisor does not necessarily make a good instructor. An instructor does not necessarily have to be an exceptional Diesel man. A person that has a faculty for knowing where to look for his information and then putting this across to other men, is the man for the job. One of the hardest things to do on a railroad is to take time enough to look up the correct information. It is proven, however, that if a few seconds are taken to look up the information, time is actually saved.

An instructor must be picked for his ability to get along with men, his ability to put over his points, and his working knowledge of the Diesel.

On the Job Instruction

The most vital instructions are those given on the job. There each man is dismantling a job for repairs, repairing the removed parts, reapplying the removed parts, and making inspections.

Manuals and other technical data should be readily available to the work and explanations given as to how they are to be used. Tolerances, clearances and other pertinent data are not easily remembered, consequently, they should be accessible. Many times a workman cannot find his information as he is looking in the wrong part of the manual. Most of the different manufacturers have indexed their information but not to a great enough degree.

The workman must be taught how to read the viscometer for checking of oils and after reading it what the reading means and the necessary steps following the reading. He must be taught the various uses of gauges, dial indicators and various other instruments peculiar to the type of locomotive. An electrician who has had very simple work to do before must be taught the use of a megger and what it means. The high potential test must be understood by him. The air gap, lift and wipe of the different contactors and relays should be explained. Each class of workman, in other words, has his own particular things to learn.

This is where a supervisor must have a good basic knowledge, as he must be able to explain and show how to attempt and complete the job. Should a supervisor be

given the added job of instructing the men as well as getting the work done and the equipment out in the time allotted? Not unless only a few locomotives are used.

An instructor should be assigned for the training of the men. In this way, there is no confusion between the foreman's job and the separate requirements for constant control of quality and training as to the proper methods. Manufacturers' representatives may be of great assistance in this respect. A careful check of the supervisors should be made as one not qualified to instruct could create an untold amount of misunderstanding. Many times it has been voiced by railroad employees that, "It is not what we have to learn that is hard, but what we have to unlearn." A workman working on a misdirected job can cause delays, failures and undue expense.

If possible, supervisors who are to be in charge of Diesel work should be given instruction at the manufacturer's schools.

These schools, however, do not make an expert out of anyone. After these schools have been attended, special supervisor classes must be set up where additional work, planning and studying can be accomplished.

Checking the finished job is up to the foreman but the instructor can be of additional assistance as he can see if the instructions that he is giving are being followed. If the men that he is instructing are not taking hold of the job, then, a follow-up job or a review of the procedure is imperative.

After the locomotives are in service, a series of classes should be arranged which will cover much more technical details of individual parts.

In most cases the same instructor used in the preliminary instruction handles the classes but as the size of the Diesel fleet increases more instructors should be created. An instructor's job is almost double and many times more than double the time involved in the actual class time. The instructor's job is a full-time job and must be so arranged.

It was suggested in the preliminary instruction that all persons involved should attend—now is the time to segregate them. The electricians should attend the electrical classes and the machinists the mechanical classes. In special instances, it could be suggested that all personnel be invited. For example, a meeting night which is to have a lecture by some outsider and the topic is of general interest.

During off-the-job instructions, it would be well to take up the individual parts that are to be worked on in the coming schedule. In other words, the machinists may take up the constructional details of a water pump and what is necessary to repair it and put it in first class condition.

For electricians, the subject of setting of relays, for pickup and drop out, air gap, wipe and lift are delved into. Trouble shooting and how to do it systematically should be outlined. There are visual aids to cover phases of electrical short-comings, such as commutation, control maintenance and motor maintenance. The repairing of relays, contactors, voltage regulators and drum type switches is another very important item.

All of the larger items should be covered in these off-the-job instructions. The smaller items can be handled on the job, but, of course, they should not be ignored. If class time permits, these smaller items can then be taken up.

Do not consider that once taught means fully learned. When one man learns a job he passes his knowledge on to another and if he does his job the wrong way, everyone following him does the same. A careful check must be kept to see that the standard of production is kept. Where several infractions are being noticed a class must be held on that particular item. If it is only one person, it will not be too big a job to get him straightened out.

This is a job that is mainly the shop instructor's job. He must work very closely with the foreman as each one cannot get the true picture of everything that is taking place. The foreman cannot do it as he is too busy seeing that the work is outlined and kept moving. If, however, the foreman finds a job that is not moving right or is slowing up the schedule then the instructor should be called in to locate the trouble and reinstruct the personnel involved so that the same condition will not happen again.

A check should be made to see that the men are consulting the manuals, texts and manufacturers' maintenance bulletins. If not, they should again be stressed.

Do not forget the supervision can get behind just as easily as the personnel. It would be well, possibly, for a supervisors meeting to be held periodically and if revisions of the instruction manuals, etc., have been issued since the last meeting, those changes should be discussed and delved into using that means for review. When no changes have been issued, then just a review of some particular piece or system that has given trouble recently could be discussed with the possibility of elminating a recurrence.

The members of the committee were Glenn E. Rodgers (chairman), supervisor Diesel instruction car, Atchison, Topeka & Santa Fe; R. F. Whitlow (vice-chairman), supervisor of Diesels, Chicago & Eastern Illinois; E. H. Holloway, general Diesel supervisor, Central of Georgia; W. P. Miller, assistant supervisor Diesel & motor car equipment, Chicago & North Western, and J. H. Whipple, Jr., superintendent of Diesel equipment, Denver & Rio Grande Western.

Heavy Overhaul of Diesel Engines

W. L. Huebner, Chairman

Heavy engine overhaul will be determined by routine maintenance-type of service and the economical cost of repairs. The care that the Diesel engine receives at its maintenance terminals such as inspections, cleaning and the type of maintenance is set up on schedules. Some roads may find it to advantage to follow routine maintenance and set up a periodic change of engines based on time, unit mileage or fuel consumption. Other roads may follow routine maintenance schedules and change engines when the crankshafts have reached maximum wear limits as established by engine builders or when difficulties occur which can not be repaired while the engine is in the locomotive.

Diesel engines can be operated for considerable mileage but the heavy overhaul should be given at a period when the cost will be at a minimum. With proper routine maintenance, engines may economically operate for total mileages or years shown in the table.

In many cases Diesel engines have been operated considerable more mileage than shown before any heavy engine overhaul, with no great amount of trouble experienced. These mileage figures are based on practices followed by the various railroads. The Santa Fe bases heavy engine overhaul on the condition of the engine.

INSPECTION PERIODS — GEAR TRAINS

Type engine	Freight, Years	Passenger, Years	Switch, Years
E.M.D.—567	4	4	4
Alco—12½ by 13	2	2	4
Alco—244B	2	2	2

INSPECTION PERIODS — CYLINDER ASSEMBLIES

Type engine	Freight, Years	Passenger, Years	Switch, Years
Winton—201A	..	1	1
E.M.D.—567	1½	1½	1½
Alco—12½ by 13	1	1	2
Alco—244B	1	1	2
Baldwin—VO	1	1	2
Baldwin—600 Series	1	1	2
Fairbanks-Morse—O.P.	1	1	2

INSPECTION PERIODS — MAIN BEARINGS

Type engine	Freight, Years	Passenger, Years	Switch, Years
Winton—201A	..	1	1
E.M.D.—567	1	1	2
Alco—12½ by 13	1	1	2
Alco—244B	1	1	2
Baldwin—VO	1	1	1
Baldwin—600 Series	1	1	1
Fairbanks-Morse—O.P.	1	1	2

INSPECTION PERIODS — CONNECTING ROD BEARINGS

Type engine	Freight, Years	Passenger, Years	Switch, Years
Winton—201A	..	1	1
E.M.D.—567	1½	1½	1½
Alco—12½ by 13	1	1	2
Alco—244B	1	1	2
Baldwin—VO	1	1	1
Baldwin—600 Series	1	1	1
Fairbanks-Morse—O.P.	1	1	2

OVERHAUL PERIODS — ENGINES

Type engine	Freight, Miles	Passenger, Miles	Switch, Years
Winton—201A	......	1,000,000	6
E.M.D.—567	750,000	1,250,000	6
Alco—12½ by 13	750,000	1,000,000	6
Alco—244B	750,000	1,000,000	6
Baldwin—VO	750,000	1,000,000	6
Baldwin—600 Series	750,000	1,000,000	6
Fairbanks-Morse—O.P.	750,000	1,000,000	6

To cover heavy engine overhaul, the subject is divided by engine parts and the recommended overhaul procedure that is now in practice.

Crankcases—On some engines the crankshafts and bearing supports are located in the oil pan, while on others they are in the crankcases.

At heavy engine overhaul periods the crankcases should be thoroughly cleaned and carefully inspected for cracks and other defects to determine what repairs will be required. The crankcases can be cleaned with a spray gun and solvent. If the engine has been removed, one of the best methods of cleaning the crankcase is to submerge it in a vat of caustic solution to remove all the old paint, grease, oil and sludge. The caustic solution must be removed by thoroughly washing with steam and hot water and blown dry with compressed air.

On cast crankcases, if any cracks are found, it will not be possible to make repairs by welding and the crankcase will have to be replaced. At the present time no satisfactory means of making permanent repairs to the cast crankcases has been found.

When cracks are found in steel fabricated crankcases, they can be repaired by electric welding or by welding a patch over the crack. Cracks in cylinder head retainers have no detrimental effect on the engines, if they are located and properly repaired before they reach the cylinder head seats or water passages. Cracks in the lower six inches of the retainer are repairable by drilling a ⅜-in. hole through the retainer ³⁄₁₆ in. beyond the end of the crack, in line with the crack, to stop further progress.

Serious failures can be avoided if small cracks in crankcases are detected by Magnafluxing and properly welded at heavy engine overhaul periods. Extreme care should be taken in the preparation and welding of the cracks to avoid distortion through weld deposit shrinkage and excessive heating. When welding cracks in crankcases and oil pans, it is a good practice to drill a ¼-in. diameter hole ½ in. beyond each end of the crack to stop further progress of the crack during preparation and welding. In the process of welding, each weld bead should be peened while hot partially to stress relieve and should be inspected to make sure all traces of the original crack have been eliminated. Allow ample time for each weld bead to cool.

When cylinder liner bores have been damaged, they can be built up by electric welding and machined, bringing them back to their original dimensions. If pitting is found in the cylinder head retainer bores, these can be machined and stainless steel insert rings applied. Some roads prefer electric weld and machining for the cylinder head bore in preference to the stainless steel ring.

When the engines have been removed from the locomotives for heavy engine overhaul and dismantled, the main bearing supports, bearing caps and studs should be inspected. The main bearing caps should be applied and tightened and the main bearing supports checked for alignment and out-of-round limits. When the out-of-round limit of .002 in. on the main bearing bore is found on any support or A frame the bearing supports must be lined bored. The crankcase or oil pan may be returned to the engine builder for this work or it may be done in your own shop. In the past few years a number of roads have been line boring their own crankcases and oil pans, with machines they have designed and built, and have experienced no difficulties.

The crankcases and oil pans of Diesel engines should last for years if they are properly maintained and repaired at time of heavy engine overhaul and should only require replacements when destroyed or damaged through accident or breakage within the engine.

Crankshafts—The early engines had machined crankshafts of nickel-chromium steel, while the engines being built today have drop-forged crankshafts of carbon steel with electro-hardened surfaces on the main and crank pin journals. The procedure and repairs of these crankshafts will be identical in all cases.

Whenever crankshafts are removed from the engine they should be Magnafluxed and carefully inspected for cracks and all journals measured for wear. If the crankshaft journals have reached the wear limits, as set up by the Diesel engine builders, it will be necessary to recondition the crankshaft. The most desirable method is to grind the journals to an undersize diameter. To do this, the crankshaft must be sent either to the original manufacturer or to shops where special machinery has been set up for doing this work.

In cases where bearing failures or breakage within the engine has caused an individual pin to be scored and all the remaining pins and journals are in good condition, it is possible to successfully grind the scored pin to a standard undersize without removing the crankshaft from the Diesel engine.

At the present time, tests are being conducted on chrome plating of worn journals and grinding them to their original dimensions. Tests are also being made on the repairing of damaged journals by a sleeving process.

Camshafts—The camshafts on some engines are made up of flanged segments and on other engines they are one continu-

ous shaft. The camshafts should be given visual inspections whenever it is possible and should be Magnafluxed and all journals measured for wear, whenever removed from the engine. When the journals have reached their limits of wear or other defects found, it will be necessary to apply new camshafts or segments as required.

Connecting Rods—Connecting rods should be cleaned, Magnafluxed for cracks and inspected for damage whenever they are removed from the Diesel engine. The basket or cap should be applied to the connecting rod and the bore measured for wear and out-of-roundness. On engines which use the blade rods, the bearing fit should be checked on a mandrell. All connecting rods should be checked for parallelism and any rods found bent should not be re-applied to the Diesel engine.

The connecting rod eye should be measured for out-of-roundness and wear limits.

The inspection of the connecting rods will be made at the time of piston inspections and removed when any defects are found.

Main and Connecting Rod Bearings—Whenever main and connecting rod bearings are removed from the engine they should be cleaned and examined for shelling, pitting, wear and evidence of working in the bore. It is a good practice to measure the wall thickness of all main and connecting rod bearings each time they are removed for inspection. The connecting rod bearings should be applied in the rods to check the bearing fits in the bore and measured for out-of-roundness.

When bearings are removed for shelling, pitting, wear or any other defects, they should be scrapped. Some tests have been made on relining of the bearings but this has not proven satisfactory up to this time.

On E.M.D. 567 engines the lower half of the main bearing is removed and inspected on every annual inspection and if any defective condition is noted the upper half is removed and inspected. On every two-year annual inspection, both the lower and upper main bearing halves are removed and inspected.

It is the practice on the Santa Fe to remove and inspect all main and connecting rod bearings when: any bearing metal is found in the crankcase or on the lubricating oil filters; defects are indicated; lubricating oil becomes diluted with fuel oil or contaminated with water; and when any engine is reported or found to have low lubricating oil pressure.

Cylinder Heads—Cylinder heads should be thoroughly cleaned and inspected for cracks and damaged seal surfaces. The repair of cylinder heads is generally an accepted procedure which amounts to regrinding valve seats, application of new valve guides and testing the water space for leaks.

In grinding the valve seats, it is recommended that a high speed grinder be used and that all valve seats are kept within the manufacturer's standards.

Cracks which have developed in cylinder heads have been successfully welded, remachined to manufacturer's specifications, and have operated for considerable mileage without any difficulty. A repetition of welding on the same cylinder head is not advisable and the general practice of welding cylinder heads is not being used by many of the railroads.

Pistons—When pistons are removed for mileage or any defects, they should be thoroughly cleaned and inspected for cracks, scuffing and scoring. The carbon deposits must be cleaned out of the ring grooves and oil drain holes and along the face of the ring lands and off of the piston crown.

The piston should be measured for wear and kept within limits set up by the manufacturers. New rings should be used at each installation of the piston to insure quick seating and will eliminate ring difficulties.

The clearance of the rings in the ring grooves should be checked and if they exceed the wear limits as specified, the grooves should be refinished and over-width rings installed. The machining for over-width rings applies particularly to aluminum pistons. Some roads have successfully reconditioned aluminum pistons by first cutting away the worn ring lands, then applying new metal, and finally remachining to original dimensions.

When cracks develop in the crown of the large aluminum pistons, they can be chipped out and welded up by either electric or acetylene process if care is taken so the distortion is held to a minimum. This procedure has been in use by a number of railroads for the past few years and satisfactory results have been obtained.

Cylinder Liners—Cylinder liners should be inspected for scale in the water jacket, thoroughly cleaned and reconditioned each time they are removed from the Diesel engine.

The cylinder liners should be checked for scoring and other defects, water tested for cracks and leakage at the plugs and liner studs, Magnafluxed, and measured for wear. All liners should have the ridges at the top of the ring travel removed and cylinder liners, which are not chrome plated, should be honed to remove the glaze from the liner wall.

When cylinder liners have reached their limits of wear, they can be refinished to the next oversize or can be brought back to their original dimensions by porous chrome plating. The cylinder liners can be returned to the manufacturer for reboring or this can be done by the railroads in their own shops. The porous chrome plating of cylinder liners should be done by a specialist in this work.

We have found that the cylinder assemblies on the E.M.D. 567 types of engines will operate in all classes of service longer than 1½ years without any difficulty, but they are changed out at this period due to deterioration of the liner seals. At the present time, liner seals of different material and design are being used and it is believed that they can be safely operated two years or longer without experiencing any water leaks at the seals.

Gear Trains—The gears, bushings, stubshafts and all parts of the gear train and accessory drive gears should be thoroughly cleaned and inspected for cracks and measured for wear each time they are removed from the engine.

When defects are found or the wear limits are reached, the parts in question should be renewed so as to bring all back to standard. Tests are being conducted by the Burlington in the use of reground stubshafts and undersize bushings on E.M.D. 567 engines and the results are said to be quite successful.

Timing Chains—When timing chains have been removed at heavy engine overhaul periods they should be thoroughly cleaned and inspected for wear and other defects.

No mileage inspection has been set up on timing chains, but they may be continued in service if no defects exist until the full range of the idler sprocket adjustment has been utilized. When the timing chain slack can no longer be taken up, a new chain must be installed or serious damage to the engine will result.

Blowers—When blower bearings become worn enough for rotor interference, aluminum dust will appear in the support housing and in the air box. An oil leak at the blower oil seal will also show an excessive amount of oil at these locations. The blowers should be removed and overhauled when these conditions are found or other defects exist.

Blowers should be removed and overhauled at time of heavy engine overhaul. Whenever blowers are removed from the engines they should be carefully inspected and the oil seals tested for leakage.

When blowers are removed for overhaul or defects, they may be returned to the manufacturer for repairs or they can be satisfactorily repaired in your own shops if the specifications and tolerances set up by the manufacturers are closely followed.

Superchargers—Superchargers of the Buchi type should

have the bearings removed and inspected at each semi-annual inspection in all classes of service.

The superchargers should be removed and overhauled when defects occur; abnormal vibration is found or the length of the free running period of the rotors are not within the manufacturer's specifications. Superchargers should be removed and overhauled at each annual inspection on engines in road service and one three-year annual inspections in switching service.

The superchargers of other types should be removed and overhauled at each annual inspection in all types of service or when defects are indicated.

When superchargers are overhauled the specifications and tolerances set up by the manufacturers should be followed and after they are completely assembled they should be tested for speed, temperatures and pressures.

Governors—The governor should be removed, dismantled, cleaned and inspected on engines in all classes of service on two year annual inspections and should be overhauled at time of heavy engine overhaul or when removed because of defects.

Governor defects in practically all cases are caused by dirt in the governor and they can be cleaned and completely overhauled in company shops with proper tools and test equipment.

Lubricating Oil Pumps—Lubricating oil pumps should be dismantled and overhauled when removed from engines when defects are indicated, at time of accessory drive inspections and at heavy engine overhaul periods.

When lubricating oil pumps are dismantled, all parts should be thoroughly cleaned and checked for wear and other defects. All dimensions and clearances must be kept within the limits set up by the manufacturers.

When the overhaul of the lubricating oil pumps has been completed, it is a good practice to check the displacement of the pump to see that it is within the manufacturer's specifications.

Water Pumps—Water pumps should be overhauled whenever they are removed from the engine for defects or other engine work.

When the water pumps are dismantled, the drive gears and ball bearings should be carefully inspected and all parts should be cleaned and measured for wear and inspected for defects.

Fuel Injectors and Nozzles—When fuel injectors are removed from engines for defects or other engine work, they should be tested to see if the nozzle valves are seating properly, the opening pressure and pressure drop are within the safe limits.

If the injectors are not within the safe limits or are removed for defects, they should be overhauled.

Fuel injector nozzles should be removed on each quarterly inspection and the opening pressure of the nozzle valve checked and the nozzle tested for defects. If the nozzle does not function properly or has been removed for any defects a new or overhauled nozzle tip should be applied and the tip removed should be overhauled.

The fuel injectors and nozzles can be overhauled in company shops, if special tools are purchased and the proper dust-proof facilities are set up.

Fuel Injection Pumps—The fuel injection pumps should be changed on engines in road service at annual inspections and on two-year inspections on engines in switching service, or when any defects are indicated.

When the engines are being assembled, the nuts on the crab studs, cylinder liner studs, main bearing and connecting rod caps and basket cap screws should be tightened with a torque wrench to the figures recommended by the builder.

After the heavy overhaul is completed, the engines should be properly load-tested to correct any water, fuel oil, or lubricating oil leaks, to see that the bearings operate at the proper temperatures, and to break in the engine.

The Santa Fe gives an engine a four-hour full-load test after heavy engine overhaul periods. When difficulties are experienced with engines losing water, low lubricating oil pressure, improper loading and at the completion of annual inspections, the engine is load tested in order to determine its exact condition.

After the load tests are completed, the compression clearances of all cylinders on two-cycle engines are checked and recorded, the main bearing cap nuts, connecting rod nuts or basket cap screws are re-tightened to with a torque wrench. The rocker arms are removed and all cylinder liner nuts and crab stud nuts are also re-tightened to the torque figures. All external nuts and cap screws on the engine are re-tightened and all final adjustments and inspections are made at this time.

After the engine is in service and comes into the routine maintenance terminal for its first work, which is 3,500 miles in freight service, 4,500 to 5,000 miles in passenger service, and on the first monthly inspection for switching service, the rocker arms are again removed and the cylinder liner nuts, crab stud nuts, connecting rod cap nuts or basket cap screws are again re-tightened with a torque wrench to the figures recommended by the engine builders. When any cylinder assembly is changed, this procedure of re-tightening the assembly on the first work after the application is followed.

On routine maintenance inspections, compression clearances on all cylinders of the two-cycle engine are taken and recorded at time of monthly inspections. The rocker arms are removed on each quarterly inspection and the cylinder liner nuts and crab stud nuts are checked to the torque figures.

With proper load testing, the removal of cylinder assemblies at 1½ to 2 years of service, re-tightening of cylinder assemblies after application and on quarterly inspections, we have successfully eliminated water leaks on Type 567 engines.

Strict routine maintenance schedules, basing of heavy engine overhaul period on the wear of the crankshaft journals and defects in the crankcases, following the engine builders specifications and proper inspections and load testing of the Diesel engines have greatly contributed to our success in economical operation of the Diesel locomotives in all types of service.

The members of the committee were W. L. Huebner (chairman) supervisor of Diesel engines, Atchison, Topeka & Santa Fe; H. F. Mackey (vice-chairman) division master mechanic, Atchison, Topeka & Santa Fe; F. Thomas, assistant to general superintendent motive power, New York Central System; K. M. Darling, engineer of Diesel equipment, New York, New Haven & Hartford; R. W. Murray; J. W. Whipple, Jr., superintendent of Diesel equipment, Denver & Rio Grande Western; R. W. Seniff, engineer of tests, Baltimore & Ohio; H. D. Parker, general Diesel supervisor, Atlantic Coast Line and W. A. Hotzfield, supervisor Diesel service, Chicago, Milwaukee, St. Paul & Pacific.

Discussion

A representative of one of the engine builders made the observation that in the last fifteen years the service procedures have had to be changed considerably to fit changing conditions. He mentioned that this 15-year period was actually divided in three parts, the first five years being considered the proving period, the next five years were the war period in which the principal job was to build a locomotive to do a job and the service problems were not too difficult during that period. In the last five years the service problems have been accelerated and the locomotives have been improved by the addition of design improvements that were developed during the war. It appears, he said, that we are now at a crossroads where some forward thinking must be done. He mentioned the fact that in the early experience with Diesel locomotives the term progressive maintenance was used and that now a term more proper

would be scheduled maintenance or routine maintenance. In other words, a Diesel engine, particularly in passenger service, formerly was maintained by doing one cylinder at a time, and the present practice is leaning toward the heavy overhaul of engines along the lines set forth in the paper.

Another member raised a question concerning the 150,000-mile general reconditioning program, when all of the cylinder liners, connecting rod bearings and main bearings are taken out of the engine at one time, and observed that one of the big problems in doing this job is that of cleaning the engine; comparisons indicate that it takes two men about 64 hours each properly to clean the crankcase while the engine is in the locomotive resulting in a out-of-service time for the entire unit of about two weeks. His further question was whether or not it might be better to remove the engine separately and replace it with another in order to cut down out-of-service time. Chairman Huebner told of the procedure on the Santa Fe and suggested that it would be better to remove the engine and dismantle it.

Another member discussed the matter of a definite mileage period at which the engine lubricating oil is renewed in view of the fact that recommendations vary from 30 to 100 thousand miles. The general opinion seemed to be that oil changes should be based on the characteristics of the oil regardless of the mileage and that dependance should be placed upon the advice of the chemical laboratory. One member said that on his road there was no definite mileage for oil change other than at each annual inspection but each time the locomotive comes to a terminal a viscosity reading is taken and a blotter test made. The oil is examined for water and if the viscosity reading is satisfactory the oil is considered safe. Each 90 days a sample is taken from the crankcase and sent to the test laboratory and if the report from the laboratory indicates that nothing is wrong, the oil is changed. In describing this system the member concluded his remarks by saying that of a fleet of 97 locomotives maintained at one terminal there are very few that do not run from annual inspection to annual inspection which in many cases means the accumulation of 300 to 350 thousand miles.

A builder's representative, called upon for suggestions, said that it was their recommendation to change oil each six months on switchers, at 30 thousand miles on freight locomotives, and at 50 thousand miles on passenger locomotives. He commented on the fact that observations in the field were that with heavy duty oil in 1,500 hp. engines the detergent became inactive somewhere between 15 to 30 thousand miles so that with an oil of this type the advantages gained by the use of new oil decrease rapidly after the accumulation of the mileage mentioned. This speaker was not in favor of mixing oils and while he recognized the value of careful laboratory control, oil run beyond the recommended mileage was liable to cause difficulties. He concluded his remarks by suggesting that it is probably more economical to change oil at the periods recommended by manufacturers than it is to pay the increased maintenance cost to get unusual mileages between oil changes.

Another member asked the question as to whether or not the membership had any cost data on engine maintenance where straight oil was used and where additive oil was used. The chairman observed that the feeling was that the maintenance cost of an engine is not necessarily influenced one way or another by oil and that while he had no figures to substantiate his conclusion he felt that the type of oil used depended both upon the recommendations and upon the type of engine.

Preparing Diesels for Winter Operation

This report is a part of the Diesel-Mechanical committee's work under the chairmanship of W. L. Huebner, supervisor Diesel engines, Atchison, Topeka and Santa Fe. It covers the special features with respect to Diesel-electric locomotives that should be taken care of to prepare for cold weather operation. The report covers the mechanical and electrical parts of the locomotive and the steam generator.

Keeping Moisture At A Minimum—First, all air compressors should carry an equal share of the load so as to keep the air temperature down to a minimum. Second, the air must be cooled well in advance of the equipment using it. In fact, it should be cooled so as to give up its moisture quickly and at a spot where it will do no harm and can be readily drained.

The air compressor should be governed electrically where more than one is used, and they should be synchronized so as to work together. Individual mechanical governors should be replaced with electric pressure switch type.

The discharge from the compressor should not dump into a main reservoir line common to the locomotive, but should pass into the aftercooler, whether it be several feet of pipe or a unit type, which is located below the car body. From the aftercooler, the line should pass into a small steel reservoir or into the first main reservoir if located beneath the car. At this point, the bulk of the moisture can be drained out of the system.

Some prefer the use of several feet of carefully located pipe as the aftercooler. Success has been experienced on E.M.D. FT type locomotives by the looping of pipe back and forth across the under side of the car body terminating it in a small steel reservoir located in front of the fuel tank. The small reservoir, as with the main air reservoirs, must be equipped with a direct drain which is readily accessible. From the small or under-car reservoir, the air should pass into the other reservoirs successively ending with the final one which is frequently located in the nose or engine room. All air brake and auxiliary equipment should receive the air supply from the final reservoir.

The problem of oil in the air becomes one for summer operation as well as winter. However, its effect is more pronounced during cold weather. A good type of piston ring for the compressor and an oil separator in the discharge line will greatly improve the condition.

In extremely low temperatures some roads add alcohol to the brake equipment air supply in order to keep it from freezing.

Fuel and Water Systems

The fuel system is a trouble maker for winter operation and it has been found that even though the pour point of the fuel is, for example, zero degrees Fahrenheit, wax crystals will form at approximately 20 to 25 degrees above. The wax will form a coating on the filters and stop the flow of fuel which will result in a Diesel engine or steam generator failure.

Some locomotives have the water tanks located so as to shield and warm the fuel tank. Some fuel tanks have been equipped with a shroud mainly for purpose of safety, however, it is also an additional protection against the cold wind.

A heater consisting of a closed steel cylinder with an internally located coil of pipe, through which a part of the engine cooling water is made to circulate, has been effective.

The heater must be constructed so that it can be shut off during the summer months or so that the fuel can be by-passed around it during that period.

Fueling facilities, especially those equipped with fuel filters, have given trouble because of wax forming and restricting the filters. A heater of sufficient size can be located just ahead of the filters which will aid in keeping them open during cold weather. It will also increase the temperature of the fuel entering the locomotive tank.

In the preparation of cooling systems, besides good maintenance of hose, hose clamps, gaskets to water connections, radiators, radiator gaskets and mounting brackets, it is important that the cooling system be clean. It should be filled and operated as the manufacturer directs.

The importance of a well maintained cooling system will be evidenced by the fact that water will not have to be added en route which might result in overfilling or freezing.

Most locomotives are built with a steam heat connection to the cooling system. On passenger power the steam heat line is connected to the main steam heat conduit, while others simply have the connection brought to the outside of the engineroom or car body.

A steam shut-off valve and a check valve are placed in the line to the engine to control the steam flow and protect against the cooling system water accidently draining through the heater line.

If the heater arrangement is to be used, the control valve and check valve must be kept in the best of condition. These valves must be tested periodically as a regular maintenance item.

Since the temperature of the cooling water has a direct effect upon the temperature of the lubricating oil, operating schedules and conditions sometimes require the use of stand-by heaters if, of course, the engine is to be shut down for an appreciable period.

The lubrication of the various parts of the Diesel locomotive is not affected by the approach to and during winter-time operation to the extent experienced with the automobile. That is, there are not quite as many changes necessary, however, the importance of proper lubrication does present itself more profoundly during those severe months.

On many railroads there is no change at all in the types or weights of oil, greases or gear compounds, however, it has been found advisable on some locomotives to use different gear compounds in the traction motor gear cases.

Engine Room Air Supply

Although the securing of an adequate amount of air and at the same time filtering out all possible dirt is a year-around problem, the condition is complicated during the winter operation by snow either passing through the carbody filters into the engine room, or even worse, coating over and restricting them.

The air required by the engine, traction motor blowers, air compressors, and on some locomotives, the steam generator, is of such proportions that a negative pressure in the engine room actually exists. This means high air velocity through the carbody or door filters, where used, and likewise, good dirt impingement or filtering.

Under such conditions, there is a great amount of turbulence in the engine room, which, during snow or dust storms, produce rather unpredictable results, with the generator and electrical cabinets being the main victims. As the filters become restricted, the area is reduced, the velocity is increased and the turbulence is further increased. As the pressure drops off in the engine room, any and all openings become sources of the air supply, with the result that snow or dust is pulled into the generator pit and high voltage cabinet through the drain openings.

As long as the engine room air is at a negative pressure, the complete blocking of carbody or door filters during winter operation such as a snow storm should be avoided.

All filters should be left open and a guard or deflector installed over the engine room side of each one in order properly to control snow which finds its way through the filters. Where door filters are used, it has been found desirable to install a deflector on both the outside and inside.

Some roads block out some filters in the vicinity of the steam generator on both sides of the car so as to keep it from freezing. The real problem is to keep the cold air away from it, as the snow which might fall around it, alone, would be of little consequence.

The car body filter deflectors should be constructed and installed so as to direct the air away from the generators and electrical cabinets. Snow falling on or along the side of the engine will do no harm. E.M.D. has provided deflectors on the late F-3 and new F-7 locomotives which are, basically, fixed multiple shutters or louvres.

Two possible answers or at least aids to the problem lie in what will be developed through the use of special outside mounted deflectors, and pressurizing of the engine room. The latter is the real answer to the entire problem. Of course, the pressurizing air must be filtered, and the bulk of the snow must be kept out.

Year-around maintenance of the cooling system shutters and controls is important, however, it is even more important that they be in the best of condition for the winter operation. There must be no binding in the shutters or the linkage and they must be adjusted so as to close completely.

When using E.M.D. Type FT locomotives in winter service involving snow it has proved desirable to block closed the section of shutters adjacent to the high voltage cabinet in order to keep snow from entering the electrical cabinet through its ventilator. If it is not desirable to block the shutters, then a cap can be installed over the air duct in lieu of the other arrangement.

Many of the older locomotives on the various roads have been equipped with either roof ventilators, ventilators adjacent to the steam generator, or other special arrangements to fit their respective needs. Since the additional ventilation has grown out of the need for more engine room air under, particularly, summer operation, most of the special ventilators are blocked closed for winter operation.

Winter operation of Diesel switching locomotives resolves itself into mainly one problem, that of keeping the cooling system sufficiently warm, which in turn aids in the successful operation of water type cab heaters.

On all switching locomotives, the shutters must be adjusted to close properly, and even then where the fans operate continuously canvas or sheet metal are sometimes used to cover a part of the air intake. Older Alco switchers, having oil and water radiators built into the sides of the hood and normally cooled with motor-driven fans operate successfully with canvas over all or a part of the radiators depending on the requirements.

There is little that need be done regarding the cooling fans, fan controls and fan clutches in passing from summer to winter operation, however, there is one exception on E.M.D. F-3 and F-7 locomotives which are equipped with a.c. motor driven cooling fans. In summer operation, the shutters are set to open before the fans start, while in winter operation that is not desirable and provision has been made, through a switch, to reverse the procedure. That is, the shutters open after three fans have started and will close before the fans stop producing better temperature regulation for cold weather.

It has been found desirable to have a slight delay in the opening of the shutters on Alco road locomotives in relation to the operation of the cooling fan during the winter.

Railroads have a predetermined cleaning and inspection schedule for all air brake equipment and other pneumatic

devices on the Diesel-electric locomotives which not only conforms with the requirements of the Bureau of Locomotive Inspection of the I.C.C., but includes special attention found necessary for their particular operation.

However, it has been found necessary occasionally to supplement the regular cleaning schedule of such devices as the horn, bell, and sanding relay valves during the winter months.

Protecting Electrical Equipment

The power equipment housed in the high voltage cabinets, the traction motors, the main generator and all of the connecting cables, are particularly susceptible to moisture due to the high potential or voltage involved. Grounded conditions of sufficient magnitude to energize and pick up the ground protecting relay, cases which institute a flash-over to ground at the generator or traction motors and further deterioration of the electrical insulation of the cables, are the major conditions resulting from moisture.

All insulation involving high voltage must be kept clean, free of oil, dry, and if necessary, coated with a good flexible oil resisting insulating varnish. The traction motors must be kept clean so as to guard against deterioration of inspection cover felts or gaskets. The covers must properly fit the motor and all cap screws must be tightened securely. The air discharge vents of the motor must be kept open, although guards have been successfully applied which shield the opening without impeding the air flow.

The traction motor blower, the main purpose of which is to supply cooling air for the motors, must be kept in the best of condition so as to aid in keeping moisture out of the motors. Needless to say, the flexible air ducts to the traction motors must be in good condition and they must fit and maintain a seal where a movable joint is involved.

The power cables leading to the traction motors are subjected to rain, snow and ice, and every care must be exercised to make certain that they are properly sealed leaving the conduits or ducts at the underside of the car. They must be properly supported, making certain that the clamps are well insulated. Wood clamps, impregnated with insulating varnish are used almost exclusively, however, clamps made of a composition material have been developed and I understand, are being tested. Although the initial cost is more than the wood clamp, the insulating qualities and durability may make them more economical. Further testing will produce the answer.

Various methods are now in use for the connecting and insulating of the traction motor cables beneath the car. Whether the connectors are bolted together or coupled through a glad hand arrangement, the contact surfaces must be kept in good condition and must be securely fastened. Whether the insulation over the connector be tape, a rubber hose, a fibre tube, or combination of these it must be properly applied, making certain that the joint is tightly fitted to the cable insulation at both ends. The moisture must be kept away from the cable.

Attempts have been made to pressurize the electrical cabinets on later road locomotives by the use of a motor-driven blower and by diverting some of the air from the traction motor blowers. These arrangements have improved this condition but the real answer to this problem is to prevent as much snow as possible from entering the engineroom and deflecting the snow that does enter the engineroom away from the cabinets. The vents in some locomotives are constructed in such a way that snow entering the car body was scooped into the cabinet. It is necessary to change the position of the vents to overcome this condition.

Cab Heaters

The cab heaters should be located so as to re-circulate the air within the cab, the fresh air being supplied in a controlled manner through windows or special ventilators. The air supply should not be taken from the engineroom or connecting parts as it would be possible to bring engineroom fumes into the cab.

The heaters on passenger locomotives should be constructed and piped in such a manner that it is possible to apply steam from the trainline when it is necessary to shut down the engine.

The shut-off and regulating valves in the steam heat lines to the heaters must be checked periodically to make certain that they will function when needed. The check valves and main valves must be properly maintained to prevent leakage. A leak at these valves might result in loss of engine cooling water.

It will be impossible to keep the windshields free from sleet and ice with the best of defrosters unless the cab heaters will properly heat the cab as the defrosters must have warm air to be effective. A good many times the defrosters are condemned when actually the cab temperature is low due to defective cab heaters.

If batteries are in good condition and the specific gravity properly maintained, it is possible to have trouble-free battery operation during the winter months.

Care should be exercised to see that water is not added to the battery prior to or at the time power plant is to be shut down for an appreciable length of time as water floating on defective cab heaters.

It will be necessary to increase the setting of the voltage regulators on locomotives equipped with electric cab heaters to keep the batteries at the proper gravity in the winter months. The ideal setting of the voltage regulator will maintain the specific gravity of the electrolyte at about its fully charged value without using an excessive amount of water or heating up the battery.

Care of the Steam Generator

In order to supply sufficient air to enginerooms, many filtered openings have been made in the car body of the later passenger locomotives. Therefore, the temperature in the engineroom remains fairly low, in fact, the controls on the steam generators have been known to freeze. Enclosures have been applied to the Type DRK and OK steam generators which have eliminated this difficulty. A coil type of steam heater to the water pump, taking steam from the trainline side of the separator stop valve, will supply sufficient heat within the enclosure, even though the steam generator is not in use, to prevent the controls from freezing.

The water pump heater, when installed must be equipped with a suitable steam trap. If it is discharged directly back into the water return line to the tank, it will overheat the supply water to the steam generator. With this application, the heaters can be turned on for the entire winter months and no difficulty experienced.

The boiler water tanks are provided with steam heat from the trainline, but if used, frequently result in too much heat causing the water to become too warm to be picked up by the water pumps. On E.M.D. four-unit locomotives with two steam generators located in the booster units and water tanks in all four units, heat can be applied to the tanks in the control or cab units only and thereby heat the water trainline connections to keep them open. It is possible to operate the entire winter with steam cut into just these two water tanks.

The latest locomotives have a water trainline arrangement which connects the water tanks of all units. Steam heat is provided to these lines through connections at the water tanks in each unit. If these heater valves are used the water supply to the water pumps will become too hot. We have found that these heaters are not required as heat from the water tanks will prevent any freezing of the trainlines.

The water tank fillup lines have been a source of considerable trouble in winter operation and a number of heater ar-

rangements have been applied to the lines by the locomotive builders without much success.

On E.M.D. locomotives, it has been necessary for us on the Santa Fe to rework the heater system on the fillup lines to prevent freezing. We are now running a ⅜ in. copper line from the steam trainline to the tee in the water fillup line and then follow the fillup down each side of the unit and making three or four turns around the check valve and into a steam trap on each side of the locomotive. This heater line is lagged to the fillup line to hold the heat. The check valves in the fillup lines have grooves ground in the seats so they will drain and thereby prevent them from freezing closed. A ½ in. drain line has been applied just above the check valve seat and a ⅜ in. drain line applied in the bottom of the elbow at the strainer screen compartment. The locomotives are operated with the fillup line heaters turned on at all times during the winter months.

On Alco locomotives, no heat is used on the fillup lines. A ⅜ in. drain hole is drilled in the bottom of the fillup line at the water strainer so that it will properly drain. No trouble has been experienced with this arrangement. The drain hole is tapped out and a pipe plug is applied for summer operation.

The use of heater lines is a source of trouble and requires considerable amount of maintenance. There is also danger of their freezing up when the locomotive is cut off the train at intermediate terminals and the steam is blown out of the trainlines.

We are planning a test by running separate fillup lines from each side of the locomotive to the water tank eliminating the check valves and water filler caps. With this arrangement, the heaters on the fillup lines can be eliminated and no freezing experienced.

The covers over the exterior fillup connections had a tendency to freeze closed due to draining of fillup lines, and this was overcome by cutting a corner from the cover to drain the cavity properly.

With the present fillup arrangement and overflow lines considerable hazard is created due to the water which overflows freezing on the platforms at the watering stations. We are conducting a test by repiping some of the water tank overflow lines down the ends of the units and discharging at the center of the track. The arrangement has some merit.

Some steam generators are equipped with exterior heaters and these should be turned on in the winter months. The discharge should be handled through a trap and not run into the water return line as it will overheat the water in the supply tank. The discharge from the trap must be directed away from the rail and the traction motors. On Type DRK and OK steam generators, the external heaters should be connected in series with the water pump heater which will eliminate the use of another valve and steam trap. With this arrangement, the heaters should be turned on for the entire winter season.

The steam conduits and gaskets are a source of trouble and require considerable maintenance. On the Santa Fe, we have set up a program on Vapor type conduits to overhaul them completely at the time of annual inspection. We have also set up a program to change all conduit gaskets once every three months. This is worked in a cycle so all gaskets on the locomotive are not due at the same time. This is important and we have greatly reduced delays due to changing steam conduit gaskets.

At the present time, improvements are being made in the steam conduits such as: new gaskets of different material and dimensions, new gasket ferrules and conduits having chrome plated gasket seats.

The steam heat expansion joints should be repacked on a definite program, making certain that the joints are in good condition, thereby eliminating leaks enroute.

The steam heat lines on the leading cab units must be freed of condensation either by cracking the end valve, using a small choke or by a special bleeding arrangement. The best arrangement is to apply a small steam trap to the trainline line just behind the end valve.

The coil blow-down and separator blow-down valves must be located above the floor with their drains located so as to blow free of the traction motors and rails, and at the same time avoid loosening and throwing track ballast. The drain lines should be kept as short and direct as possible to prevent freezing.

Blow-down bells, similar to those used on steam engine injectors, have been applied pointing backward and down between the rail, and have been helpful in eliminating damage to the track ballast.

Modern Diesel Servicing Stations

H. E. Niksch, Chairman

Diesel locomotive servicing facilities are generally concentrated at maintenance terminals as these locomotives are capable of making long runs with little time required enroute for servicing. It is, however, necessary that water and fuel be supplied without delay on long distance passenger and freight runs while at stations or when train is being handled.

Passenger locomotives require water for heating boiler tanks at points approximately 150 to 200 miles apart and fuel oil approximately 800 to 1,000 miles apart. Freight locomotives in through service usually receive supplies of fuel oil and sand at intermediate terminals 200 to 300 miles apart, however, careful location of servicing facilities in many cases serve both passenger and freight locomotives.

Modern servicing facilities for serving trains enroute are usually located adjacent to passenger station platforms. They consist of fuel and water storage tanks of ample capacity, necessary water treating equipment, pumping stations for both water and fuel oil and conveniently located outlets for supplying locomotives.

Because of the complex nature of the steam generator the highest quality water is desirable for trouble free operation. Clean condensate or distilled water with a small amount of corrective treatment therefore provides an ideal water for steam generators. This, however, is impractical in most areas due to prohibitive costs and it becomes necessary that railroads use more economical treating facilities. In areas where reasonably good natural waters are available facilities for treating steam locomotive waters, such as zeolite plants, internal treating plants or lime soda plants can be used for furnishing waters for Diesel steam generators by using a supplementary treatment. Many railroads, however, have found it economical to install de-ionizing plants, particularly those in the western states where natural water has a high mineral content. Water can be so treated for about one cent per 1,000 gal. per lb. of dissolved mineral removed.

These plants when used at terminals provide excellent water for storage batteries and Diesel cooling water systems. When used in cooling systems special treatment should be added in controlled quantities containing chromate type inhibitors. Where possible, properly treated cooling water should be supplied through a system including a storage tank, pumping equipment and pipe systems to supply water to locomotives at all points in the terminal, thus assuring uniformly treated water to all engine cooling systems.

Diesel locomotive terminal servicing facilities usually center around a sanding arrangement. Care should be taken when locating these facilities to accommodate conventional equipment for storing and handling either wet or pre-dried sand reasonably close to the dispensing station. These sanding installations have been constructed in many varying arrangements depending on the type of locomotive used and the volume and importance of the power being serviced. They usually consist of an arrangement of sand tanks and piping to serve locomotives at one spotting.

It is advantageous to combine sanding facilities with other servicing functions, such as fuel and water delivery system and locomotive body and truck washing equipment.

It is also desirable to locate locomotive washing facilities inside the maintenance building where locomotives can be washed on any working shift the year around without exposing employees to inclement weather.

Fuel Storage

The large scale increase in the use of Diesel locomotives is making it necessary for railroads to concentrate large Diesel fuel oil storage and handling facilities at key points. They should permit rapid fueling, adequate filtering to insure keeping foreign particles out of engines, reliable metering for keeping records and finally a fire protection system to eliminate hazards around this highly inflammable material.

A terminal using approximately 20,000 gallons of fuel oil daily has been provided with three 250,000 gallon steel storage tanks. These tanks are protected by earth dykes and piped for foam fire protection equipment. Each tank is piped direct to the pumping plant. This plant is connected to two remote controlled unloading stations, one for receiving fuel oil by transport truck and the other for unloading tank cars. It also furnishes fuel to two remote controlled dispensing stations, one located in the maintenance building for fueling road locomotives and the other located adjacent to a service station handling switch locomotives in 24-hr. service.

The pump is of 200 g.p.m. capacity used normally for pumping fuel from unloading stations to storage tanks. A smaller pump of 100 g.p.m. capacity is used for supplying fuel to service lines. Each pump is equipped with suction strainer, air relief valves and filters. Fuel is filtered before entering storage tanks and again when pumped to dispensing stations. This plant and the remote control stations are operated by explosion-proof electrical equipment. The pump control and piping system is so arranged that either pump can be used to handle fuel from the unloading station to either storage tank and also supply the service line, thus not interrupting operation if one of the pumps fail.

Modern lubricating oil facilities are an important requirement at a Diesel terminal. They not only make an efficient operation through speeding up oil changes and normal servicing requirements, thus saving handling expense, but permit keeping premises clean, free of fire hazards and eliminate the use of barrels for handling new oil and crank case drainings.

A terminal using three kinds of lubricating oil in locomotives was recently provided with modern facilities. Three storage tanks are located in the basement of this building directly beneath the pumping equipment. The valves and piping to these pumps permit handling oil from tank car to storage tanks as well as from the storage tanks to dispensing stations. These pumps are provided with suction strainers and are operated by explosion-proof electrical equipment. They are of 25 g.p.m. capacity and are controlled by push button switches from the tank car unloading station and the oil dispensing stations.

[The report described, in considerable detail, the facilities for dispensing oil to the locomotives at the filling stations and also described equipment for draining and filling engines.—Editor.]

One of the most important functions of a modern Diesel servicing facility is equipment for cleaning air and lubricating-oil filter elements. This equipment must be designed to suit the type of filters handled at the maintenance point, promote clean operation and provide clean, dry filters in an efficient economical manner. (A typical filter cleaning installation was described in the report.)

The members of the committee were H. E. Niksch (Chairman), master mechanic, Elgin, Joliet & Eastern; V. C. Golden, superintendent motive power and equipment, Chicago, Indianapolis & Louisville; L. L. Luthey, assistant supervisor Diesels, Atchison, Topeka & Santa Fe; W. C. Marshall, assistant to superintendent motive power, Chicago, Milwaukee, St. Paul & Pacific, and W. P. Miller, assistant superintendent Diesels and motor car equipment, Chicago & North Western.

Above: A modern small terminal service station—
Below: Indoor Diesel locomotive washing equipment

Car Officers Suggest Constructive Changes

Chicago convention suggests numerous changes in A.A.R. rules — Stresses the need for better-trained car forces

The 27th annual meeting of the Car Department Officers' Associations was held at the Hotel Sherman, Chicago, September 19 to 22, incl., with about 450 railway car supervisors participating. Three subjects particularly stressed, were the need for more effective training of men in all branches of car department work, how car men can help improve train-yard operation and numerous constructive changes suggested in the A. A. R. interchange, billing and loading rules.

The meeting was called to order by President P. J. Hogan, supervisor car inspection and maintenance, N. Y., N. H. & H., and principal addresses were presented by J. F. Doolan, vice-president, N. Y., N. H. & H., New Haven, Conn., and J. J. Brinkworth, vice-president, N. Y. C., Chicago.

Seven major committee reports were presented on the following subjects: Modern General Repair Shop Operation and Methods; Loading, Interchange Rules and Billing for Car Repairs; Analysis of Train-Yard Operations to Improve Performance; Responsibilities of Car Department Supervision; Air-Conditioning Equipment-Operations and Maintenance; Modern Methods of Freight Car Painting.

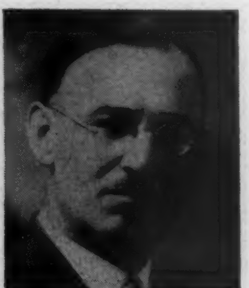
P. J. Hogan, President
(Supervisor car inspection and maintenance, N. Y. N. H. & H.)

Election of Officers

At the close of the last session, the following officers were elected for the ensuing year: President, G. H. Wells, assistant to superintendent car department, N. P., St. Paul, Minn.; vice-presidents, J. A. Deppe, superintendent car department, C., M., St. P. & P., Milwaukee, Wis.; J. D. Rezner, superintendent car department, C., B. & Q., Chicago; W. N. Messimer, general superintendent equipment, Merchants Despatch Transportation Corporation, Chicago; A. H. Keys, superintendent car department, B. & O., Baltimore, Md.; secretary-treasurer, F. H. Stremmel, assistant to secretary, Mechanical Division, Association of American Railroads, Chicago.

The new board of directors includes J. S. Acworth,

G. H. Wells, Vice-President
(Assistant to superintendent car department, N.P.)



A. Deppe, Vice-President
(Superintendent car department, C.M.St.P.& P.)

W. N. Messimer Vice-President
(Superintendent equipment, Merchants Despatch Transportation Corps.)

F. H. Stremmel, Sec.-Treas.
(Assistant to secretary, Mech. Div., A. A. R.)

assistant vice-president, General American Transportation Corporation, Chicago; G. R. Andersen, superintendent car department, C. & N. W., Chicago; F. Cebulla, master car builder, G. N., St. Paul, Minn.; W. P. Elliott, general car foreman, Terminal Railroad Association of St. Louis, St. Louis, Mo.; L. H. Gillick, vice-president, Vapor Heating Corporation, Chicago; H. H. Golden, A. A. R. supervisor, L. & N., Louisville, Ky.; P. J. Hogan, supervisor car inspection and maintenance, N. Y., N. H. & H., New Haven, Conn.; H. A. Harris, master car builder, G., M. & O., Bloomington, Ill.; H. L. Hewing, superintendent of interchange, Chicago Car Interchange Bureau, Chicago; J. E. Keegan, chief car inspector, Pennsylvania, Chicago; H. S. Keppelman, superintendent car department, Reading, Reading, Pa.; G. E. McCoy, assistant chief car equipment, C. N., Montreal, Quebec, Canada; J. A. MacLean, Jr. president, MacLean-Fogg Nut Company, Chicago; J. P. Morris, assistant to vice-president, A., T. & S. F., Chicago; I. M. Peters, secretary and superintendent, Crystal Car Lines, Chicago; L. Richardson, assistant general manager, N. Y., S. & W., Paterson, N. J.; J. J. Root, Jr., vice-president, Union Tank Car Company, Chicago; F. A. Shoulty, assistant superintendent car department, C., M., St. P. & P., Milwaukee, Wis.; R. Schey, superintendent car department, N. Y., C. & St. L., Cleveland, Ohio; G. P. Trachta, general superintendent motive power, C., R. I. & P., Chicago; H. H. Urbach, general superintendent motive power and machinery, C., B. & Q., Chicago; J. A. Welsch, superintendent of equipment, I. C., Chicago.

President Hogan's Address

As car department officers we are the key men in our profession, a necessary cog in the wheels of progress of the railroad industry. Therefore, in addition to duties in connection with car design, construction and maintenance, we must work with the shipper, endeavoring in every way possible to build up shipper good will and thus get and hold business.

In this connection I suggest that the Association of American Railroads be urged to give consideration to the application of established improvements to side-door posts of box cars. This improvement may be applied so that any height of door protection, using wood or strapping, may be applied to door posts without the use of nails after the car is completely loaded. This will help the shipper reduce expenses in loading cars by eliminaing high-priced labor for nailing boards or straps one at a time to the car lining. It will do away with interference in the loading and unloading of such cars at doorways, and in addition will preserve the car lining against damage by nails.

The gondola car was in the same category until recently when the A. A. R. recommended that banding clips be applied by welding to side sheets. This improvement will greatly assist the shipper in securing open loads, reduce his expenses and at the same time preserve the car. There are many other types of band fasteners which you may wish to investigate.

The flat car is still operating with stake pockets requiring the use of strap protection and when rods are used to secure the load to the car, large plate washers with holes are required, all of which are expensive to the shipper. Therefore, these three types of commonly-used box, gondola and flat cars should be equipped to take rods, straps, etc., without the use of auxiliary items and thus save the shipper unnecessary expense and loss of time. These necessary improvements have been neglected and unless we do something to help quickly we can look forward to continued losses in certain commodities.

On the passenger car side of railroading we are experiencing many improvements and changes in mechanical and electrical systems, all of which create ideal conditions when in proper working order.

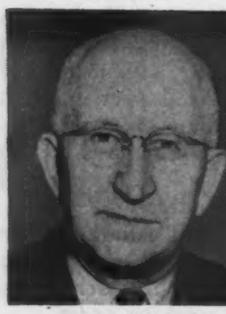
The refinements necessary to complete a cycle of operation, be it steam, water or electricity, are quite complicated in comparison with the earlier car. As an example of what I mean by complications, the New Haven recently had 10 new dining cars built. It was decided to apply kitchen and pantry equipment complying in every detail with the U. S. health regulations. Therefore, each new dining car is equipped with fluorescent lighting, mechanical refrigeration, and air-conditioning both in the dining section and kitchen. Generator capacity has been increased to 35 kw., and the battery capacity increased. Other equipment includes an automatic steam coffee maker, electric and charcoal grills, dish washer with timing motors for washing and rinsing and various other devices, all requiring a multitude of controls for the crews to operate; namely, 56 water valves, 23 steam valves and 6 air valves, all of which are used to complete the systems.

Your job as supervisor and that of your mechanics is to keep up with these advancements through practical training so as to secure the greatest possible economy in car operation and maintenance to serve the public and the railroads.

* * *

One of an order of 150 all-steel cabooses being built at the Chicago plant of the American Car & Foundry Company for the Chesapeake & Ohio

Operating and Mechanical Forces Must Cooperate



J. F. Doolan

By J. F. Doolan

Vice-President, Operations, New York, New Haven & Hartford

Contrary to conditions formerly existing, we hope that, today, every operating man knows there must be the closest and most efficient cooperation with mechanical maintenance forces. The mutual interests of these two groups of men must be recognized. A yard crew that cannot be bothered to space cars on the bad order track, will switch out "set backs" that could have been repaired in the time wasted to bar the cars apart, or cars not separated could be the cause of failure of draft gears at some future time. Delays in switching such shop tracks react upon the yard operations as much, if not more, than upon the repair forces. Tough winters augment the difficulties of both departments.

Of paramount importance is safety. Car department employees must perform their work on repair tracks protected by blue signals and also on active tracks in yards and stations where precautions must be instituted and complied with. Too many tragedies have occurred through failure to protect by the blue signal and to have the understanding necessary for personal safety. Taking a chance that the car will not move has brought sorrow to many an individual and home.

The need for safety appliances on cars can best be appreciated by those of us who have climbed over thousands of cars, in all kinds of weather and the conditions which exist in practically every railroad yard and industrial switching area. I am sure that everyone of you gentlemen feel that in this phase of his job, he is his brother's keeper.

The necessity for proper maintenance is well appreciated in the speeding passenger train and in the long freight train, with its open-top loads of piling, lumber, steel, machinery, transformers, military equipment and other heavy lading. One hot box can delay an important train to result in claims for failure to make market delivery on perishable freight and result in delay to other trains. A well-known make of anti-waste-roll-edge journal box, which we have on 500 box cars, has been in service two years with no hot box reports and practically no waste adjustment necessary. One thousand New Haven gondola cars are being equipped with loading band anchors for better security of lading and to avoid damage to the car. Four hundred and ten box cars have side-door protection and loading posts, to keep the lading away from doors.

Under present day costs it is more necessary than ever before that the highest possible efficiency obtain in our shops, repair tracks and servicing locations. Out-of-service time, particularly for expensive passenger equipment and for loaded freight cars, must be avoided to assure the retention of this business as well as to avoid road delays.

Increased costs due to the 40-hour week will require that economies be sought everywhere possible in order to avoid deferment of improvements to equipment and plant. Obviously we must depend upon supervisory forces and qualified employees to produce results in facilities and equipment designed and used to meet present day costs. Railroad employment, purchases, taxes, etc., represent stories that may have been repeated many times and may be monotonous to some, but will be worthy of repetition, nevertheless.

A Challenge To Car Supervisors

J. J. Brinkworth

By J. J. Brinkworth

Vice-President, New York Central

Let us visit any busy passenger-car yard where car inspection, servicing and repair work have a vital influence on safety. Without careful, competent car men to look after many details at this point, present safety records could not be approached.

Journal lubrication is still a problem and further efforts must be made to reduce hot boxes and improve hot-box alarm devices which do not yet give full protection. Judging by vociferous complaints, passengers think there is nothing worse than an air-conditioning failure and all a.c. equipment should be double checked at initial terminals. Electrical failures of all kinds are disturbing and further efforts are required to assure adequate heating of long trains under adverse climatic conditions.

Why do passenger trains break in two? We have too many train partings and this gives car men some explaining to do. The night foreman has an important job which must be done under difficult conditions. Superintendents complain if trains are held, day or night, but it is better to delay a train than to overlook correcting any serious defects.

There are a surprisingly small number of accidents in passenger train service due to defective equipment, in spite of tight schedules and high speeds, but an attempt must be made to stop all accidents before they occur.

One thing which railroads badly need, and we hope manufacturers will some day supply, is a car wheel which will not slide flat in emergency brake application.

In freight service, schedules have also been greatly speeded up to meet competition and this throws added responsibility on car inspectors. They must be given the full protection of blue flag rules and helped in every way to do their work thoroughly.

We are having a lot of hot boxes in freight service, cars cut out en route and burned-off journals causing accidents. Waste grabs are discovered after humping cars. Brake beam drop and many other defects develop. This raises the question if we have proper inspection. Car men say we don't give them time enough. One way or another means must be found to supply fit cars for the loads offered, avoid

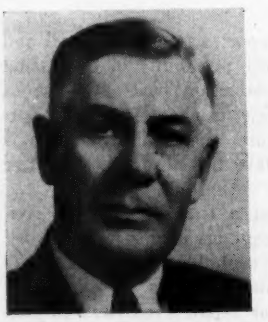
delays in transit and reduce staggering claim payments.

Relatively few complaints have been received from the public since the institution of the 40-hr. week. Car supervisors cannot avoid some additional labor cost for inspection on Saturdays and Sundays, but this can and must be minimized. In other words, have men where needed, but be sure they are needed.

With regard to the general railroad situation, the war ended in 1945, but there is still no peace. Contrary to expectations, no slump materialized in 1946, '47 and '48 and railroad traffic remained at high levels. Record amounts of new equipment were installed in 1948, but at the end of the year the railroads had less equipment than in 1943, owing to heavy retirements.

Many railroads will end the year 1949 in the red. Why? One of the reasons is the loss of both freight and passenger business to competing trucks, busses and airplanes. What can be done about it? Railroads don't want subsidies for themselves or their competitors. All they ask is a chance to get and hold traffic which it is fairly proven can be handled more effectively and economically by rail than by any other means of transportation.

Report on Modern General Repair Shops



H. A. Grothe, Chairman

Railroads make a living by operating a machine known as the modern freight car which bears but little resemblance to its counterpart of the preceding generation. The more complex demands of shipper and operation today require performance of jobs of infinite variety, coupled with stability and operating economy. How best to meet the demands of the customer and function economically is the business of the car department officer.

This responsibility can be met only by a diligent and comprehensive maintenance program which involves: Accurate detailed information regarding the condition of equipment; application of the best business skill and mechanical knowledge to get the most for the repair dollar.

Operations

Field inspections and other information indicate that a series, or a group, of cars will arrive at a state of maintenance about a year hence, that will require general repairs to avoid failure in service; to arrest progressive deterioration; or to rehabilitate service classification. A pattern of recurrence has been developed by analysis and experience. Indicated is a desired and necessary shopping frequency varying from four years up to seven years for all types except caboose cars which range from two years to four years. Within the scope of time period as given, there are a variety of classifications or subdivision of general repairs. The determination here entails considerations such as attained age, construction or service.

Location for shopping will be determined by several factors including natural flow of cars to minimize backhaul or diversion, to all possible extent. Also on the basis of availability of facilities, labor and material. Shop facilities should be arranged for one certain class of repairs in order to concentrate materials and develop efficiency in operations. Where conditions are such that separate shop points cannot be utilized for such purpose, then one shop should be arranged to accommodate one class of repairs at a time. Either method will contribute to economy in material purchase and handling, as well as the promotion of safety and efficiency in the work operation.

The planning of a program of general repairs may be processed by tabulating the various items of repairs to be performed. It will be based on knowledge acquired, for instance, in the repairs given to a sample car—one of the series or group. Based on the desired output, orders may then be placed for materials. By this process a forecast of material requirements is obtained up to a year in advance, which permits purchases to be made favorably and deliveries to coincide with the progress of the program. Benefits of quantity production may be obtained in fabricating processes, and possibiliies of shortages during the program eliminated or minimized. Calculation of re-use of repairable parts should be considered. Many hold that the salvaging of materials is a specialty worthy of distinct consideration and should not be considered as part of a repair program, and better concentrated at one reclaiming center or plant.

Spot or progressive systems provide advantages in planning the personnel because of the specialization in the various positions. Also to be considered are the incentives involved and created, in a regular routine that allots time for job completion. Another salutary result is in the opportunity for the supervisor in charge to function most efficiently, the attainment of which reflects back from the shop management to the supervisor himself. Most positions will function as planned most of the time. This permits and obligates the foreman to concentrate on any weak positions and to correct them. He has the privilege, when in desired production schedule, to realize the fulfillment of his obligations and thereby renew currently a satisfaction that produces highly prized enthusiasm.

An essential is a record in simple form to follow the progress of the general repair programs to the extent of cars repaired and their average cost. These become the basis for program forecasts as well as budget requirements. Stimulus is provided to attain cost improvement by the comparisons afforded.

Methods

With the repair work detailed in the spot positions of a progressive system, there is the greatest challenge and opportunity to refine individual operations.

The progressive method of stripping and erection is the most efficient and safest operation. Stripping positions should be isolated from erection positions. Stripping tracks should be spaced to provide either a running track or wide roadway between each working track in order that materials removed from cars may be separated between salvage and scrap and disposed of or moved by the use of industrial cranes or heavy duty motor vehicle crane type units, or other suitable powered units.

Cars should be advanced from the stripping position to the sand blasting or paint stripping position where all paint and stencilling should be removed either by sand, shot blasting or acid bath method. Cars should be primed at this position immediately before being advanced to the fit-up position.

Fit-up positions should be so arranged as to provide ample room for the storage of all materials for two days of operation. Bins and racks should be so arranged that a one-day supply can be replenished while the other day's supply is

being used. If this cannot be accomplished, a second shift force should be used for the replenishment of materials.

From the fit-up position, cars should be advanced to the riveting position; then to the wood position for the application of floor and lining after which the car is advanced to the paint position.

Truck repairs may be a separate operation and may be located near the fit-up position where trucks can be removed and replaced by a crane or conveyor system.

Complete roofs should be assembled on a jig and all work completed in order to apply the roofs in one unit. Heavy materials should be moved to the fit-up position in carload or less than carload lots. Lighter materials should be moved to their proper positions in the bins or racks in which they are stocked at the fitting positions. This curtails handling costs materially. Other materials that can be stocked or piled on racks or platforms should be transported by lift trucks or platform trucks.

Stationary steel scaffolds should be erected throughout the entire line of repairs and the scaffold boards may be attached to counter-balanced arms so they may be raised or lowered as desired.

Hoists including swing-over types, common to the work at each spot are provided. Some spots are fitted up with jigs to permit subassembly work such as hoppers, doors, door frames, and hatch plugs. Adoption of jigs as developed in new car building is recommended for adaptation in repair subassemblies. Any arrangement that saves manual lifting, or movement either laterally or vertically, is recommended for safety and productivity. Other advantages in jig or similar assemblies are that stops provide the measurements and insure uniformity, which in turn saves hand tool operations of cutting, sawing and fitting. Such operations belong to the production machinery in the fabrication shops generally.

Overhead cranes, where available, facilitate jacking cars and handling heavy materials. Many ingenious devices and practices applicable to the various specific repair or assembly jobs are developed and made available by description through trade publications for general benefit. It is our purpose, therefore, to commend even more widespread sharing of such information in such manner, rather than to deal with any in particular through this medium.

The report was signed by Chairman H. A. Grothe, shop superintendent, Chicago, Milwaukee, St. Paul & Pacific; G. H. Comer, superintendent shops, New York Central; F. Cebulla, master car builder, Great Northern; H. G. Knudsen, general car foreman, Northern Pacific; J. A. Welsch, superintendent equipment, Illinois Central; J. C. Marsh, superintendent, car maintenance, Boston & Maine; E. L. Brown, assistant master mechanic, Staten Island Rapid Transit Co.; E. O. Dickinson, superintendent, car department, Central R. R. of New Jersey.

Discussion

The discussion following this report was quite general and spirited, particularly as regards the possibility of organizing freight-car repair work on a production basis at some of the medium and small-size repair tracks. The consensus was that more can be accomplished along this line than is now being done, if supervisors have the necessary initiative and "know-how."

For example, the adaptation of a transfer table or construction of a tail track may permit organizing repair work on a progressive basis and prevent blocking light-repair cars between heavier jobs on stub-end tracks.

The desirability of the four-year repair cycle was emphasized, also the difficulty, especially on smaller roads, in getting cars home, holding them out of service and providing storage space while enough are being accumulated to start heavy-repair programs. The cost of revamping yards, installing concrete walk-ways, also necessary power-driven equipment and modern tools, wherever conditions seem to justify, was said to be a promising investment.

(The report was accepted.)

Report On Interchange and Billing Rules

R. W. Hollon, Chairman

During the past year this committee has considered proposed revision of and additions to the present Code of A. A. R. Interchange Rules, and submit herewith the following recommendations:

Rule 9

Revise note in bracket opposite "A. A. R. Couplers, or parts thereof, R and R," as follows:

Proposed Form: Note—When other than Type-E 11-in. knuckle is renewed separately, type of coupler repaired must also be shown. When second hand knuckle is removed with coupler, type and face depth of knuckle removed must also be shown.

Reason: Rule 17 permits application of Type-E 11-in. knuckle to any type of coupler without penalty, therefore, information now required on billing repair card with respect to type of coupler to which a Type-E 11-in. knuckle is applied is not necessary and if this requirement is eliminated it will simplify preparation of repair cards in the field.

Add new second note following item of "Brake Beams R & R" as follows:

Proposed Form: Note—When A. A. R. No. 3 brake beam is applied, type of brake beam standard to car must be shown.

Reason: To support charge for No. 3 brake beam applied, if standard to car.

Rule 20 — Figs. 2 and 3

Recommend captions following these figures be modified to permit use of these shims whether or not welding or riveting facilities are available.

Proposed Form—Fig. 2: Shim of proper thickness, width and length may be applied.

Proposed Form—Fig. 3: Shim of required thickness, width and length may be applied.

Reason: Most places have riveting facilities but not welding facilities; however, it is not practical, or possible to apply a riveted shim to a large number of carrier irons, and on some cars not practical to apply a welded shim, therefore, it is felt that the use of these shims should be permissible whether or not welding or riveting facilities are available.

Rule 32 — Inter. 3

Recommend answer to Interpretation 3 be modified to indicate exterior damage is not cardable if damage is to a lesser extent than specified in Rule 4.

Proposed Form: (3) Q.—Is interior damage at owner's

risk when caused by clam shells or other devices used in loading or unloading, where handling line has definite knowledge that the damage occurred while the car was in its possession?

Proposed Form: A.—In such circumstances, the interior damage should be assumed by the road on which it occurred, it being understood that external damage (to the extent of requiring repairs, *per Rule 4*) caused by clam shell or similar machinery coming in contact with the exterior of car, shall be considered cardable in interchange per Rule 32, Par. (10-b). Handling cars in dumping machines which meet A. A. R. requirements, shall not be considered as unfair usage and damage resulting therefrom is not cardable in interchange.

Reason: To clarify the intent.

Rule 35

Modify note following this rule with respect to correct reference to item number in Rule 107.

Proposed Form: Note.—Charge on authority of defect car, per Item *71* of Rule 107, etc.

Reason: To provide correct billing reference.

Rule 101 — Item 99-H

Modify note following Item 99-H, Rule 101, to specify clearly proper labor charge for Wabcogrip and Flexigrip fittings.

Proposed Form: Note.—Air brake pipe on AB brake equipment, broken at threaded portion of the flange fitting, may be repaired by the use of Wabcogrip or Flexigrip fittings (or other A. A. R. approved types) as correct repairs, charge to be based on material applied, plus labor *for connections made and cap screws R. & R. or R.*

Reason: To clarify intent as to labor charge applicable.

Rule 101

Recommend that an item be included in Rule 101 covering labor and material charge for A. A. R. alternate standard and A. A. R. approved equivalent draft-key retainers.

Reason: To simplify billing.

Rule 101 — Items 132 — 132-E, Incl.

Recommend that allowances (new, secondhand and average credit) covering Type-D coupler parts, now specified in Items 132-132-E of Rule 101, be re-studied to determine if they are, at the present time, equitable.

Reason: As new parts for Type-D couplers have not been manufactured for a number of years, and as the service value of such parts, whether secondhand or reclaimed is considerably less than at the time these allowances were placed in the rules, and as very few, if any, Type-D coupler parts are reclaimed at the present time, it is felt that the allowances now specified in these items for secondhand, reclaimed and average credit, should be confined to scrap value.

Rule 107 — Item 138-A

Recommend Item 138-A be modified as follows:

Proposed Form: Spring plank, in trucks with cast-steel truck sides having integral journal boxes: R. & R. or R., of truck springs and shims, in connection with exchange of one or two pairs of wheels, or truck sides, or bolsters, in same truck.

Reason: All references in Rule 107 to combination charges in which wheels were involved in trucks having other than truck sides with integral journal boxes were eliminated in the revision of Rule 107 per P. C. Docket 2039, therefore, this Item should be corrected by elimination of the word, *not.*

Rule 112 — Sec. A

In view of recent increases in labor rates, suggest allowances specified in the following paragraphs covering cars damaged in unfair usage be revised to provide an equitable allowance for each of the various operations.

Par. 1—(b) (3)—Allowance for unloading car sent home loaded on another car.

Par. 1—(c) (3)—Allowance chargeable versus car owner for temporary or partial repairs on car returned home on its own wheels, at request of car owner.

Par. 1—(c) (4)—Allowance for loading car, when owner retires car, returned home loaded on another car at his request.

Par. 1—(d)—Allowance for dismantling car.

Rule 120 — Par. (c), (e) & (f)

Recommend repair limits for labor on car body, now specified in Par. (c), for various types of cars and allowances for repairs authorized as specified in Par. (e) and (f) be revised upward, to compensate for increase in labor rates.

Reason: To provide equitable allowances for repair limits on cars requiring general or extensive repairs due to owner's defects.

P.C. Rule 7 — Sec. (j)

Recommend a new paragraph, numbered (j) (2), be added to Sec. (j) to permit cleaning of passenger car brakes 30 days prior to expiration date whether or not car requires other repairs.

Proposed Form: (j) (2) When stenciling indicates brakes are due for cleaning within 30 days, brakes may be cleaned regardless of whether or not car requires other repairs.

Reason: To harmonize with Freight Car Rule 60, and to avoid rejection and setting out of loaded cars enroute due to old air date.

P.C. Rule 19

Recommend that this rule be clarified definitely to establish what is considered a passenger type truck. The Allied Full-Cushion trucks, which some consider as passenger trucks, are used under both freight and passenger cars.

Recommend also that the A. A. R. definition of passenger-train cars be inserted in this rule.

Reason: To clarify intent with respect to proper billing charges for freight and passenger type trucks.

P.C. Rule 22 — Item 41-A — Note 1

Proposed Form: Note 1.—Where connector is repaired on *or at* car, charge shall be based on actual cost of material applied (excluding coupler head), plus labor at actual time, but not to exceed 25 per cent of net charge for renewal. When metallic connector removed has defective coupler head gasket only, charge should be confined to Item 41 or 41-A. Billing repair cards must show for connectors, both applied and removed, the size, manufacturers name, and whether insulated or non-insulated; also reason for removal.

Reason: To clarify intent charge for repairs to connector performed on or at car, shall be on basis of actual labor and material expended, but not to exceed 25 per cent of net charge for renewal.

The report was signed by R. W. Hollon (chairman), mechanical inspector, A. A. R. billing department, Chicago, Burlington & Quincy; Vice-Chairman R. W. Parker, superintendent railway equipment, Tennessee Copper Corporation; M. E. Fitzgerald, master car builder, Chicago & Eastern Illinois; C. W. Kimball, assistant supervisor car inspection, Southern; F. J. Larrisey, chief A. A. R. inspector, Erie; Frank McElroy, assistant to vice-president, Union Tank Car Company; J. J. Sheehan, supervisor car repair bills, Missouri Pacific; F. Peronto, assistant secretary, mechanical division, A. A. R.; C. R. Wiegmann, superintendent, St. Louis Interchange Bureau; H. Belond, A. A. R.

inspector, Chicago, Milwaukee, St. Paul & Pacific; J. E. Walsh, superintendent, St. Louis Refrigerator Car Company; A. N. Campbell, mechanical engineer, car department, Canadian National.

Discussion

At the conclusion of this report, Chairman Hollon brought up the subject of drooping couplers and K. H. Carpenter, superintendent car department, D. L. & W., stated that, in heavy pusher service, especially on rainy or wet days, that road has been plagued with break-in-twos due to couplers swiveling in a vertical plane and disconnecting. He said that a high coupler which droops with wear at the keyway can raise 8 in. under heavy train shocks.

John McMullen, retired consultant, Erie, described a proposed slight alteration in interior design of the coupler yoke to keep the coupler in alinement and take wear off carrier iron. As this matter is now before the A.A.R. car construction committee, no action was taken by the C.D.O.A.

(The report was accepted and referred to the A.A.R.)

Report on Car Department Supervision

R. E. Baker, Chairman

In attempting to analyze the responsibilities of car department supervision, we must first consider the responsibility of the car department as a whole in the operation of the railroad, which is primarily to build, inspect, maintain and repair all cars—passenger, freight and work equipment, in a safe and suitable condition for service. This sounds simple, but on the contrary is indeed a large assignment. It is responsible for the condition and safety of all car equipment required and furnished for all types of lading, the traveling public and many employees. It is responsible for the inspection of all cars in interchange, for the inspection of lading on all open-top cars and the lading in many house cars. It is responsible for clearing tracks in case of derailments or wrecks as quickly and safely as possible with the minimum of damage to equipment and lading.

A car department supervisor is therefore charged with great responsibility. He is responsible for getting out production. He is responsible for the safety, health and physical condition of his subordinates. He is responsible for the development of morale or proper mental attitude in his subordinate group. He is responsible for cooperating with management, fellow supervisors and his own subordinates. He is responsible for training and developing his subordinates. He is responsible for keeping records and making reports.

In order to fulfill the above requirements, he must instruct, explain, interpret and enforce various rules, orders and requirements necessary for the proper operation in his department, do it intelligently and in unbiased manner.

Four Groups of Car Supervisors

Car department supervisors, because of the varied responsibility, can be segregated into four groups: Those in charge of shops; those in charge of light repair tracks (rip tracks); those in charge of train-yard inspection and lubrication and top supervision in charge of the entire department.

The shop supervisor's concern is concentrated on high productivity and good workmanship, performed safely, at a minimum cost. To accomplish this, he must obtain and maintain good labor-management relations. He must know in advance the repair programs anticipated and adopted in advance a definite plan for this operation. This requires physical check of facilities, machinery and shop layout to detect and overcome any and all barriers. It requires close relations with all subordinates to know that the definite plan is understood. It requires close relations with the stores department to know that the required materials are available. It requires constant check of each operation to detect and correct any and all conditions retarding progress. It requires alertness to discover and apply new mechanical devices and techniques to secure greater efficiency of production. Responsibility for these requirements rest with the shop supervisor who, in carrying them out, must not overlook cost. He must have a practical understanding of managing cost and know how to manage the cost under his control.

The light-repair-track supervisor has the same responsibility with respect to production, good labor-management relations, safety, stores department relations and cost but, in place of a definite building or rebuilding program, he is confronted with the operation of light repairs. He is responsible for the safe maintenance of equipment in service, for the necessary repairs required to keep it in service. He must have close and friendly relations with operating department supervision to provide necessary switching, to furnish information as to outstanding bad order cars, their status as to lading importance, and whether perishable or slow freight. He must know at all times the exact number of bad order cars on hand, not only on the repair track but in the yards, and the nature of defects. He must plan the operation of the repair track so that daily production holds to a minimum the number of bad order cars on hand.

The supervisor in charge of train-yard inspection and lubrication is responsible for the performance of the car inspectors and oilers, the men who decide whether or not the equipment is safe for service. He must be familiar with the operating department rules. He must be in close contact with the operating department and render service satisfactory to that department. He has a definite responsibility in the education of inspectors and oilers in respect to acquiring good judgment, the lack of which may or could result in disaster.

Top supervision in the car department is responsible for the coordination of all men in the department to see that proper instructions are isuued to subordinates; repair programs are laid out; men are trained for advance positions; train delays are studied and corrective action in connection therewith.

The A.A.R. interchange rules, loading rules, air brake and safety appliance rules contain the fundamentals of car department work and in part or as a whole govern its various operations. Car department supervisors, in order to carry out their responsibilities, must have a thorough knowledge of all of these rules and requirements, and, in addition, a sense of good judgment, practical knowledge of work to be performed, and good understanding of human nature. (The report here included numerous practical suggestions regarding safety work and labor relations.—Editor.)

Public Relations

All supervisors have a definite responsibility in public relations. The human contacts that supervisors make day to

day, both on and off the job, present an opportunity to develop good public relations. Their contacts with the various shippers within their respective territories, the contacts at public gatherings, clubs and social affairs afford the opportunity to sell railroad service. It should be remembered that railroads have only two things for sale—namely, service and scrap. A supervisor should always speak well of his railroad, should do so with enthusiasm, never hesitate to defend it, tell of its good labor relations with employees, its service, its new equipment and fast trains. In other words, be a salesman, and to be a good salesman one must be courteous. The supervisor should stress the importance of this feature with all of his employees so that they too will become salesmen, will realize that their security as railroad employees depends upon the traveling public and the shippers.

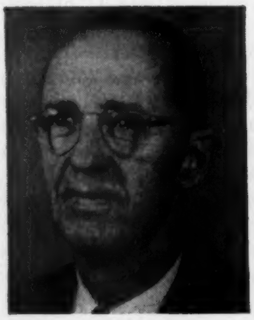
The report was signed by R. E. Baker (chairman), assistant general manager, Boston & Maine; K. H. Carpenter, superintendent, car department, Delaware, Lackawanna & Western; A. H. Keys, superintendent, car department, Baltimore & Ohio; H. S. Keppelman, superintendent, car department, Reading; J. E. Slaven, assistant superintendent of safety, Chicago, Burlington & Quincy; W. E. Symons, superintendent car maintenance, New York, New Haven & Hartford; E. W. Gebhardt, assistant superintendent car department, Chicago & North Western; R. G. Setzekorn, mechanical superintendent, American Refrigerator Transit Company; R. D. Bryan, mechanical assistant, A. T. & S. F.

Discussion

The concensus was that this report reflects painstaking work by the committee and conveys a message well worth taking home. One fact brought out was that the car foreman at a small repair point is often like a friend or father to carmen employed there and the result is about three times more efficiency than is usually found at larger shops. This same spirit should be carried into large car shops to the fullest extent practicable.

(The report was accepted.)

Report On Air-Conditioning Equipment



C. S. Albright, Chairman

The failure of air-condition equipment causes more unfavorable comment than that of any other equipment on trains. It is hard to understand human nature. Persons can work and live in buildings that are not air-conditioned for 300 or more days out of a year and never make any comment. However, let them take a trip on a train once a year, and ride either in a non-air-conditioning car, or in one that has an air-conditioning failure, and they are complaining continuously to train personnel, and to general officers, who realizing what these complaints can do to business, are continuously insisting on better maintenance of air-condition equipment.

A year ago this committee pointed out that in order to combat air-conditioning failures, all railroads had set up instructions for maintenance and calling for certain work to be done daily, monthly, annually, etc. While this work would vary in detail, in general it would be about the same for electro-mechanical, Pullman-mechanical, steam-jet and engine-powered systems.

It was also pointed out that mechanics servicing the equipment and making the inspections, play an important part in the over-all results obtained. Supervision must be on the alert to note positively that all service operations are being performed, and that, in case of failure, each individual case be followed through to a conclusion so there will be no repetition of this type of failure. There have been too many cases where air-conditioning failures have been perpetuated, two, three or four days in succession before the cause was corrected. In many cases, this correction has been made only after the matter had been brought to the attention of someone in the higher supervisory ranks.

Daily and periodic inspections play an important part for a number of reasons. The inspector must be familiar with all the details of the equipment involved. He must know what tests to make and be able to determine just what work will be required at the terminal, previous to dispatchment.

The men performing a.c. inspection and maintenance need definite instructions, education and experience to do an A-1 job. The fundamental requirement is education of the men performing the various duties involved. Some system of education must be set up. In setting up such a system it should be kept in mind that not every man working on car electrical and air-conditioning equipment is willing to spend his time to improve his ability through home study. The problem here is no different than it is in public schools, as far as personalities are concerned. Some are eager to get all the information possible, others are passively interested, and still others are not interested at all, if it takes any effort. Each railroad must determine just what method of education will be required.

There are several methods by which an educational program can be handled, and every railroad should develop this program along lines most suitable to its particular needs. In some cases this can best be accomplished by use of an instruction car. Another method would be to hold classes at maintenance points where it would be possible to leave classes and go to a car in the yard for inspection of actual equipment. Manuals, drawings and various types of literature on changes in practice should immediately be made available to the maintenance forces so that service men would be kept up to date on equipment at all times.

After we have educated the man, we must have the yard facilities with which he can do the work. These play an equally important part in the maintenance of air-conditioning and refrigeration equipment.

Considering the larger maintenance points, terminals where 50 or more cars are dispatched every 24 hours need more facilities than those dispatching fewer cars. The larger the number of cars dispatched within a short period of time, the better the facilities must be. Lack of proper facilities results in too many lost man hours. This may easily run as much as 20 per cent, even higher.

One of the most essential requirements is a yard which will permit an entire train to be assembled and lined up as early as possible and as far ahead of departure as possible. Once lined up, the train should not be moved so that maintenance forces may safely perform all the inspections and repairs necessary whether in or under the car. This should be accomplished by a blue flag at each end of the train to

insure safety for the men who are making inspections and repairs. There should be a regularly assigned track for bad order cars that require heavy repairs. Cars on this track should be moved only after cars are repaired or released by the maintenance forces.

The platforms and crosswalks should be wide enough to permit industrial trucks free and unobstructed passage, not only for servicing cars, but for the transportation of all maintenance parts which do not require a drop table to apply. On the platform, approximately every 80 or 85 ft., there should be a 220-volt 3-phase 60-cycle receptacle for testing and inspecting electro-mechanical-equipped cars and cars with motor generators. This receptacle can also be used to charge car batteries from portable motor-generator sets. Stores facilities should be at a location which will reduce travel for materials to a minimum.

One of the most important facilities required is a drop pit for removing heavy equipment such as motor generators, as well as wheels. Along with this should be an inspection pit for the under car inspection if necessary.

One or more small industrial trucks of a type which can carry up to 1000 lb. for equipment with grease materials and guns for periodical greasing should be provided, also one for filters and one for other small parts used in repairs so that repairs can be made without waste of time. Fork-lift, platform-lift or other types of trucks will assist the maintenance forces.

This report was signed by C. S. Albright (Chairman), supervisor, electrical appliances, New York Central; G. A. Shaffner, general supervisor, air conditioning, Chicago & North Western; J. A. Fitzpatrick, air-conditioning supervisor, Baltimore & Ohio; R. F. Dougherty, general electric and air-conditioning inspector, Union Pacific; W. A. Woodworth, general inspector, air conditioning and car lighting, Southern Pacific; H. J. Dawson, traveling electrical inspector, Illinois Central; M. L. Edgren, development engineer, Pullman Company; J. J. Doherty, air conditioning and electrical foreman, Chicago, Milwaukee, St. Paul & Pacific; T. J. Lehane, Vapor Heating Company, and K. T. Benninger, general electric supervisor, Chicago & Eastern Illinois.

Discussion

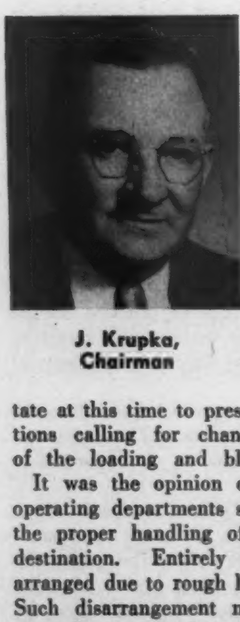
In discussing this report, several members mentioned the interdependence of electrical supervisors and their respective car foremen. Further instruction of maintenance men was urged and this presents quite a problem, as many of them appear more or less indifferent and unwilling to attend classes in instruction cars or elsewhere unless paid for their time.

The importance of better qualified operating, as well as maintenance, forces on air-conditioning equipment is such that individual railroads are urged to appoint system men to spend their entire time in educational work on the line. One of their major duties will be to follow up all defects and failures, making sure that full information regarding causes and remedies is made available to men at outlying as well as major repair points.

One car foreman said that hot boxes, wheels and air-conditioning are the three things causing most trouble in passenger car maintenance and the last is a big job. He recommended periodic inspection and attention at least twice a month, with both the car foreman and electrical foreman personally supervising the check-ups to make sure that a.c. equipment gets as much attention as wheels, trucks, draft gears and other major car parts.

(The report was accepted.)

Report on A.A.R. Loading Rules



J. Krupka, Chairman

In the study of the rules, many changes could be recommended which in the opinion of the committee would tend toward better and safer loading. However, there is much to be accomplished under the present rules by promoting a clearer understanding of the rules as they now exist, both by the shippers and the carriers. With this thought in mind, we hesitate at this time to present a large number of recommendations calling for changes that would increase the cost of the loading and blocking.

It was the opinion of the committee that the carriers' operating departments should be requested to cooperate in the proper handling of loads to insure safe handling to destination. Entirely too many open-top loads are disarranged due to rough handling both in yards and in trains. Such disarrangement not only causes delay to the shipment, but results in unusual expense to the carriers transferring or adjusting loads.

With reference to the specific loading, it has been noted that a decided improvement has been made in the number of loads of lumber that have become disarranged from one cause or another which tends to indicate that the recommended method of securing loads of lumber is adequate under normal conditions. However, we still experience an excessive number of disarranged car loads of small-size lumber. The principal difficulty in such cases is endwise shifting.

Due to the hazard as a result of such shifting, the committee recommended that loads of lumber of this type be placed in the head end of local trains with a speed limit not to exceed 30 m.p.h. It is also suggested that trains with loads of this type be stopped and inspection made ahead of every passenger train. If this is not considered feasible, then this type of lumber should not be loaded above car sides, preferably should be loaded in box cars. However, it is expected that considerable opposition would be presented by shippers to the loading in this type of car.

In the interest of simplifying the loading of open-top cars, attention is directed to a circular letter dated April 22, 1948, by V. R. Hawthorne of the A. A. R. with reference to the application of hold-down clips on steel gondola cars. Compliance with this letter will not only simplify such loading, but will reduce the cost of loading and blocking this type of load and will reduce if not entirely eliminate the mutilation of gondola cars by burning holes in side and top chord angles. This practice causes much damage and weakens the structure of cars when resorted to.

Proposed Changes In AAR Loading Rules

Fig. 27: Covering loading of entirely creosoted and other poles. Recommend this figure and specification be deleted.

Reason: Experience has proved that many of the side stakes, Item B, are failing in connection with endwise shift-
spection Bureau.
ing of load due to the use of tie wires, Item C, which extend through load and secure to side stakes. When load shifts,

the wires move with the load exerting sufficient pressure on the side stakes which are stationary in side stake pockets to break them. Figs. 27A and 27B which are similar in most respects to Fig. 27 except that they do not require use of cross tie wires through load. The committee feels that the provision of these figures and specifications is more suitable for this type of lading than Fig. 27.

Ingot Molds: It is recommended consideration be given to furnishing a figure and specification to cover the loading of this commodity which is not now covered by rules.

Reason: Finding instances of ingot molds being loaded in cars promiscuously without the use of bracing and blocking. The committee recommended that a new figure and specification be furnished to cover the loading of this commodity or that the present Fig. 65 and its specification be revised to include the loading of ingot molds.

Loading of Boats: The present rules do not contain any figures or specifications covering loading and securing boats and the committee recommended that consideration be given to the development of some figures and specifications.

Reason: It has been found that loading and securing boats is not uniform insofar as blocking and securing is concerned. This results in shifting and damage to lading. The committee felt that some general specifications and figures covering loading of this type would be of material assistance to both shipper and carrier.

Fig. 95: Item F covering the securing of the top layer of pipe with two high tension bands, one at each end, is considered insufficient. Recommend that two additional bands, one at each end, or other means of securing be provided.

Reason: There have been instances where band at one end failed and permitted the top layer of pipe to shift laterally and extend beyond the outside of the car.

Self Propelled Harvesters: It is recommended that consideration be given to the development of a figure and specification to cover the loading of this commodity.

Reason: Present rules do not contain any figure or specification to govern loading of this type. Consequently this commodity is not being loaded in a uniform manner. As a result many shipments are found to be in a disarranged and damaged condition. To illustrate, we are quoting a letter written by a general car foreman along with photographs submitted covering in detail the difficulty experienced with a shipment of this kind:

"Am attaching hereto pictures of car loaded with self propelled agricultural implements. There are no special loading rules governing this machinery. There were three of these loaded on this car.

"You will note from the illustrations that the front wheels of these machines are cocked in wheel blocks. This is due to the fact that the hold-down wires do not serve this purpose and it is my suggestion that the front wheel axle be secured to the car floor. These combines are wired with only No. 4 wire looped on each side of each machine. There is a chute for each machine, as illustrated which is secured to the machine chute on the end of the car. Should either of these wires fail, this chute which measures 2 ft. by 9 ft. would fall off the car.

"This car was on our repair track May 27 on account of two broken wires and the others loose.

"The front wheel blocks are formed to the shape of the tires.

"Am also suggesting an additional wrapping to secure the chute."

Loading Mounted Car Wheels: Many railroads have special cars to handle mounted car wheels, which do not require blocking as specified in Figs. 111 and 112. There are no figures or specifications now in loading rules indicating whether these cars are acceptable in interchange.

Self-propelled harvestor machine with front wheels cocked in blocks with hold-down wires too small and too loose—Vertical chute at right insecurely held

Reason: Inasmuch as this type of car is being interchanged under load in movement between carriers and wheel manufacturers the committee suggested that some figure and specification should be developed to cover.

Fig. 111: Covers the loading of mounted car wheels cross-wise but no figure is included or mention made which would permit loading of mounted car wheels lengthwise in gondola cars.

Reason: One of the railroads, through tests made, feels that lengthwise loading of mounted car wheels in gondola cars lessens the possibility of journal damage. The committee suggested that consideration be given a figure and specifications to cover this type of loading.

The report was signed by J. Krupka (Chairman), general car foreman, Chicago, Burlington & Quincy; H. L. Hewing, superintendent, Chicago Car Interchange Bureau; W. P. Elliott, general foreman, Terminal Railroad Association of St. Louis; W. A. Emerson, superintendent, car department, Elgin, Joliet & Eastern; J. F. Likarish, general car foreman, Great Northern; W. R. Hall, district supervisor car maintenance, Chicago & North Western; T. S. Cheadle, chief car inspector, Richmond, Fredericksburg & Potomac; W. G. Syverson, general car foreman, New Haven, and A. C. Bender, joint inspector, Cleveland Inspection Bureau.

Discussion

In connection with this report, slides were shown indicating undesirable loading conditions. Joe Marshall, retired representative, A.A.R. Freight Claim Division, suggested that these illustrations be reproduced in bulletin form and circulated to car men in the field so they can see conditions and devise corrective methods. He also pointed out that draft gears designed for earlier types of 40-ton cars give entirely inadequate protection in heavier cars moving at modern stepped-up speeds.

Favorable comment was made of improved lumber loading in the Northwest where an "on-the-ground" committee collaborated with the West Coast Lumberman's Association.

A question was raised regarding the holding power of nails in Great Lakes steel flooring and G. R. Andersen, superintendent car department, C. & N. W., said the nails have good holding power and will not pull out with anything less than a claw-bar. He also stated that movable clips on the bulb angles of gondola cars are the answer to burned holes for improved load securement.

(The report was accepted and referred to the A.A.R.)

Locomotive Boiler Problems

Association hears reports on subjects dealing with practical problems of boiler maintenance and design

E. H. Gilley
Vice-President
(General boiler foreman, G. T. W.)

E. H. Heidel,
President
(General boiler inspector, C. M. St. P. & P.

A. F. Stiglmeier
Sec.-Treas.
(General supervisor boilers and welding, N. Y. C. System)

THE thirty-second annual meeting of the Boilermakers Association was held at the Hotel Sherman, Chicago, September 19-22, with an attendance of 258 members and guests. Reports, addresses and discussion emphasized the role that boilermakers have played in the past in improving the steam locomotive and what they can do in the future to increase further the safety, reliability, performance and availability of steam power.

President Heidel opened the meeting by asserting that the day of the really efficient and economical use of steam power is yet to come, and that the possibility of a national emergency cannot be entirely discounted, at which time all steam locomotives would possibly be used to capacity. He reminded members that the officers did not ask them to concur in all the findings and recommendations of the various committees, but that they did want constructive criticism, considered opinions, personal experiences and observations to augment committee reports.

Following the president's opening remarks the meeting was addressed by H. J. Burkley, superintendent motive power, Baltimore & Ohio, who called attention to the fact that America is the only country where associations or organizations of subordinates can hold such meetings as the one in progress, and assemble for general discussion on the improvement of motive power, the first line of defense of the nation. Mr. Burkley recalled some of the changes made in the past 50 years—how the link and pin gave way to the automatic coupler, the steam jam to the air brakes, and the pump connected to the rear crank pin to the injector. Bolts and rivets were driven by hand throughout the entire boiler and firebox; arch tubes and brick arches, syphons and circulators were unheard of, and water treatment was unknown. Today these conditions no longer exist because boilermakers and supervisors have insisted that improved methods be developed.

Secretary-treasurer Stiglmeier spoke on the relationship of the master boilermaker to the federal locomotive inspectors. He continued by emphasizing the difference between the building and maintenance of a steam boiler and that of general mechanical construction. Machinery can have slight mechanical defects which would not necessarily be a potential danger, and, in the event of a complete failure, would cause only inconvenience or delay. With the steam boiler, defects of material, workmanship or design can lead to disastrous explosions unless promptly discovered and properly corrected. The rates of progression of defects in boilers are, and will remain, unknown quantities. Many people are not conscious of the vast destructive powers contained in boilers and reservoirs and therefore little realize the dangers to which they would be exposed were it not for the watchfulness and zeal of boilermakers and federal inspectors.

Economy of operation is again becoming the foremost consideration in railroad boiler work. This

problem can often be solved by making use of new devices and new methods. Increased quality of work can be obtained generally in addition to increased production by means of modern tools, machinery and methods.

Mr. Stiglmeier's talk was followed by an address by Mr. E. P. Gangewere, assistant general manager, Reading. He discussed benefits to the railroads through having membership on committees and in discussions. He stated that the boilermaker craft would remain active for a long time from research work through which steam locomotives of high availability, low initial cost and low maintenance expense can perform reliable service. He saw no reason why well informed boiler supervisors should not progress to high general supervisory positions on an equal basis with foremen of other crafts. He quoted figures on the Reading showing the progress in the boilermakers' art, including an increase in miles per boiler failure from 166,070 in 1933 to 1,971,963 in 1948.

This year's meeting of boilermakers was addressed by the heads of government locomotive inspection bureaus of both United States and Canada. E. H. Davidson, director, Bureau of Locomotive Inspection, I. C. C., paid tribute to many generations of boilermakers by emphasizing the recognized safe construction of the modern boiler. F. S. Hartle, assistant director of operations, Board of Transport Commissioners for Canada, said that the operating department of this organization is concerned with all problems associated with practical railroad operation, from the design and maintenance of motive power and rolling stock and the investigation of accidents through the approval of train schedules operated in compliance with standard train rules. He spoke at length on locomotive boiler design and the effect on the reliability and safety of operation.

The closing address of the meeting was delivered by D. E. Mumford, superintendent of safety, New York Central. He discussed the problems involved in teaching people to work safely and presented a breakdown of causes of accidents in boiler work on the New York Central for the period 1945-49.

Election of Officers

The following officers and board members were elected to serve for the coming year: President, E. H. Gilley, general boiler foreman, Grand Trunk Western; vice-president, R. W. Barrett, chief boiler inspector, Central Region, Canadian National; secretary-treasurer, A. F. Stiglmeier, general supervisor boilers and welding, New York Central System.

Executive Board: Chairman, R. W. Barrett; secretary, Harry C. Haviland, supervisor boilers, New York Central. For one year: H. R. Barclay, general boiler inspector, Northern Pacific; F. R. Milligan, general boiler inspector, Canadian Pacific; Bernard G. Wollard, general boiler and welding foreman, Chicago & North Western. For two years: R. W. Barrett; Benjamin G. Kantner, general boiler inspector and welding supervisor, Reading; R. A. Culbertson, general master boiler maker, Chesapeake District, Chesapeake & Ohio. For three years: W. H. Keiler, locomotive inspector, Interstate Commerce Commission; Harry C. Haviland; Floyd Seeley, assistant general boiler inspector, Union Pacific.

Advisory Committee: Chairman, A. F. Stiglmeier, E. H. Gilley, and R. W. Barrett.

Advisory Board: E. R. Battley, chief of motive power and car equipment, Canadian National; B. M. Brown, general superintendent motive power, Southern Pacific; A. K. Galloway, general superintendent motive power and equipment, Baltimore & Ohio; F. K. Mitchell, manager-equipment, New York Central System, and H. H. Urbach, general superintendent motive power and machinery, Chicago, Burlington & Quincy.

The Boiler Maker and Smoke Abatement

Canadian Practice

Canadian railways are now using the master mechanic type of front end, almost exclusively. After experimenting with a varied assortment of spark arresters, this type of front end is generally considered to be the most suitable and most efficient. It is generally used with a square mesh type of netting having 2⅝ by 2⅝ mesh to the inch, with the strands made of No. 10 B.W.G. The condemning limit of the mesh opening is 19/64 in., and wire strands are condemned when they thin to .065 in. The oblong type of netting with openings not more than 3/16 in. in width and ¾ in. in length, made of warp No. 10, shute No. 9 B.W.G. is acceptable but not in general use.

The design and construction of ashpans vary considerably. The pans have been greatly improved during recent years. This improvement in design has produced a much more efficient and fire-proof pan, easier to inspect and, for the most part, easier to maintain. More attention should be paid to the production of fool-proof dumping gear, and more efficient protection for reach-rod openings at rear of pan. Drafting arrangements on ashpans on Canadian locomotives have improved considerably.

In Canada, the federal laws require that pans and front ends be given a complete examination every seven days, and ashpans a pre-trip inspection. It is my opinion that if a thorough inspection is made of all fire protection appliances at the time a boiler is washed, and all parts reasonably cool, any necessary repairs can be made at that time, and little or no trouble would be experienced with defective fire appliances between wash-outs.

I have often noticed that maintenance staffs will carefully examine dead plates for openings, and netting for wear, and then proceed to overlook spread netting strands.

One of the most prolific causes of track fires is the improperly closed ashpan door, slide or damper. In many instances, where open, or partly open, ashpan doors have been found to have been responsible for causing fires, subsequent investigation has disclosed the fact that pan door was tightly closed before the locomotive was turned out of

the enginehouse. The trouble is more often due to carelessness, or ignorance, on the part of the asphit men at turnaround points, or engine crews who find it necessary to dump the pan enroute, and it is here that the necessity for an easy-opening, and tightly but easy closing pan door, is most readily demonstrated.

The report was submitted by P. K. Ingle, district inspector, Board Transport Commissioners, Canada.

Effect of Locomotive Design

An item closely related to the subject of this paper, although entirely out of the hands of the boilermaker, is the type and quality of fuel used. Two railroads which approximately parallel each other use heavy Mikado locomotives of approximately the same specifications. Railroad No. 1 operated for the period of 1942-1948 without a single steam failure and only cleaned flues at the monthly inspection. This railroad had no coal mines on line and therefore was free to purchase coal where the best could be obtained. Their coal specifications called for a high B.t.u. screened coal minimum 2 in. lump which cost the railroad an average of 56 cents a ton more than run-of-mine. Railroad No. 2 for the period of 1942-1948 averaged 10 to 15 per cent steam failures and were required to clean flues an average of three times between monthly inspections and used an average of 20 per cent more coal per gross ton mile than railroad No. 1. Railroad No. 2 was using an inferior grade of run-of-mine coal and was constantly being cited by the local authorities for smoke violations.

In the induction of air into the firebox through the use of steam air jets it is fundamentally essential that the air be admitted as close to the fire bed as possible, in order that the air may be present at the point of distillation and thereby be accessible to the hydrocarbon molecule at the time it is evolved. Otherwise, the heat will break up the hydrocarbon molecules and the liberated carbon will form with the other carbon particles too large to be consumed in the short period of time available before being exhausted out the stack in the form of smoke.

The Master Boiler Makers' Association's responsibility in the field of smoke abatement evolves around the problem of proper design of the boiler with sufficient boiler and firebox capacity for complete combustion along with the installation of proper over-fire steam-air jets to create turbulence in the firebox and in the proper maintenance to keep the component parts of the boiler in condition for maximum efficiency. In addition to this, the association can, by working with the Fuel Association establish a goal of obtaining the best possible fuel for locomotive use. If this is not done and the smoke nuisance abated, the boilermaker will be the one to lose out if the Diesel entirely supplants the steam locomotive.

The railroads responsibility for causing fires has been grossly overstated. The largest fires that have plagued this country have originated miles from any railroad. Yet if a fire does originate within a mile of any railroad, the assumption is that it started from a spark from a locomotive. More fires are caused by carelessly tossed cigarettes from passing autos than from sparks from a locomotive.

In the front end arrangement of modern locomotives, every precaution has been taken to prevent the expulsion of fire-producing sparks and is producing results when they are properly maintained. Ashpans are so designed to prevent the dropping of hot coals which would tend to start fires, and if they are properly maintained, no fires will be encountered from this source. The primary cause of fires which are started from exhausted hot cinders, is the inferior grade of coal being used and the high degree of fine coal which permits the fine particles of fuel to be ignited in suspension in the firebox and then exhausted out of the stack to the atmosphere never having come in contact with the fire bed. This again is out of the hands of the boilermaker and is the responsibility of the fuel association.

If the front end is properly designed and maintained, the boiler and firebox maintained, the ashpan and grates properly designed and maintained and the proper fuel provided so that the locomotive steams freely, the tendency to overcrowd the fire will not be present and it can be kept in condition for maximum efficiency, thereby eliminating the necessity for frequent stops for fire cleaning and the dumping of ashpans in places where ensuing fires can start.

The report was submitted by Frank D. Heighley, district inspector, Interstate Commerce Commission.

Eliminating Smoke at Terminals

The Washington Terminal and all the railroads which operate in and out of Washington, have formed a smoke committee, which meets once a month. There are five railroads and the Washington Terminal Company represented on this committee. During the meetings if any violations have been received they are discussed and ways of preventing such a violation again are discussed.

All the foremen and gang foremen, inside and outside hostlers, fire knockers and fire builders, and any extra men who might fill any of these positions are educated to a point where, if they see any smoke being emitted from a smoke stack or even see a slight discoloration, they immediately go to that engine, find out the cause for the smoke or the discoloration and then correct it.

The educational system used consists of three phases. First, the men are taught the proper ways of building and maintaining a fire. Second, notices are placed on all bulletin boards from time to time which calls to the attention of every man working in the shops the fact that it is his responsibility to help in eliminating smoke and fly-ash. Third, we have three special duty engineers, each working an eight hour shift, on duty during the 24-hour period each day. These men give their undivided attention to the elimination of smoke. They watch for smoke in the engine house territory, and when they observe it being made, instruct the responsible individual in the proper way to do what they are doing without making smoke.

We use a portable smoke consumer on every locomotive when building the fire and have found that it will eliminate the smoke and cause about 95 per cent of the gases to be reburned. We build fires by first placing a layer of low-volatile coal in the firebox approximately 4 in. deep, having it slightly higher on both sides and at the door sheet, and then with a portable oil fire-lighter, we light the fire. The portable smoke consumer is kept on during the entire process of building a fire. We have these smoke consumers placed between every other track for the convenience of the employees, so that they can be used on all the locomotives that come into the roundhouse with the fires burning. We, also, have these placed on the fire track and as soon as an air line is run to the ready track these smoke consumers will be placed at that point, so that the engine crews may use them when they are preparing their fires. In fact there is one railroad that has these smoke consumers placed all over its yards, fire track and enginehouse.

Considering again this portable smoke consumer, the question was asked if steam would be as effective as air in eliminating smoke. Steam, while it did a very good job of eliminating smoke, was not as good as air because air makes the best turbulence in burning gases. These smoke consumers might be used on the road. If two were placed in the back head on each side of the fire door hole and an auxiliary air reservoir placed on the locomotive for this

purpose, about 80 per cent of the smoke would be cleared up on the road and entirely eliminated at stations.

The report was submitted by J. J. Desmond, enginehouse foreman, Washington Terminal.

Heat Loss Through Scale

Any condition which will increase fuel consumption will adversely affect smoke abatement. Scale on water side of firebox sheets is an important factor as it causes considerable loss of heat. The table based on determinations made at the University of Illinois shows the approximate heat losses that may result if scale is allowed to accumulate.

The blower also must be maintained in good condition, since it has a bearing on the consumption of fuel while a locomotive is in operation, particularly when drifting, as any rapid cooling of fire results in clinkers being formed, which in turn prevents air from passing through fire bed.

Loss of Heat Through Scale Accumulations

Thickness of Scale, In.:	Loss of Heat, per cent:
1/50	5.2
1/32	8.3
1/25	9.9
1/20	11.2
1/16	12.6
1/11	14.3
1/9	16.0

By proper use of the blower, formation of clinkers can be avoided and free drafting is provided.

Therefore the use of water treating chemicals is a factor in smoke abatement, since the accumulation of scale causes a loss of heat, which in turn results in increased consumption of fuel.

The report was submitted by Dennis P. Vernon, boiler foreman, Reading.

Discussion

A city air pollution control engineer from Milwaukee County said that city smoke abatement control may be superceded by county control, and that eventually by state control. This is logical to control smoke originating outside boundaries of small controlled areas.

A. A. Raymond, New York Central, said that it is necessary to educate many people to eliminate smoke. Public demand necessitates smoke control regardless of cost. One industrial company spent $50,000 to eliminate smoke, a second, $100,000, and a third, $300,000. In cleaning fires much material is emitted from the stack if the blower is opened wide. A collector can be used to take the ash to the wet ash pit. Flues should be washed and not blown. Washing not only eliminates the spreading of much dirt but gives cleaner flues. If the flues are plugged, it is sometimes necessary to drill through with air first. It would be desirable to get rid of the air even for this purpose. To eliminate smoke in firing-up the main obstacle yet to be overcome is to educate the men as all roads now have air forks or other mechanical gadgets to reduce smoke.

Hot Blow Down Versus Cool Down Washing

H. R. Barclay, Chairman

The advent of large high pressure locomotive boilers was followed by an epidemic of cracked shells, side, door and flue sheets, stay and crown bolt leaks and broken bolts. The difficulties mentioned above did not occur in smaller power with pressures in the 200-lb. range after good methods of water treatment had been inaugurated, regardless of the method used in washing the boiler or in the frequency of the washes.

Larger locomotives hauling longer trains and the use of Diesel power have reduced the number of locomotives in service. The time between washes has been extended from once daily to once a month on many railroads. The net result is that we do not have enough blowdowns to keep the hot water washout plant up to the required temperature without the addition of large quantities of live steam, a costly procedure. Any method that does not require large quantities of hot wash and fillup water is a distinct monetary saving. The cooldown method fulfills that requirement.

While the rate of cooldown, or the time it takes to cool a boiler may be important, it is far more important that the reduction in temperature be evenly distributed. The temperature should be the same in every part of the boiler insofar as possible. Uneven cooling, such as we get with hot blowdowns, sets up stresses that eventually lead to trouble. The Canadian Pacific uses the following procedure:

The locomotive arrived in the enginehouse with a pressure of 160 lb. and 1½ in. of water in the glass. At 9:25 a.m. the temperature was 320 deg. at the top check, 310 deg. at the top of the boiler dome flange, 290 deg. at the top of the wrapper sheet near the bell, and 260 deg. at the firebox side sheets. The injector was started at 9:30, and shut off at 9:36 with ½ glass of water and 75-lb. pressure. The steam heat valve was opened at 9:40 and all steam pressure released from boiler at 11:10. Temperature readings were then 240 deg., 280 deg., 270 deg., 210 deg., respectively at the four points previously mentioned.

At 11:15 cold water with a line pressure of 60 lb. was started, maintaining one-half glass of water in the boiler until shut off at 12:47. At 12:50 washout plugs were pulled to release water from boiler. The boiler emptied and washing was started at 1:05. Cooling time was 3 hours and 25 minutes. Temperature readings at this time were 90, 201, 235 and 140 deg. The temperature of the wash water was 100 deg.

Summary of the Canadian Pacific method of cooling boiler is as follows: Fill boiler with injector until it breaks, maintaining ½ glass of water by opening blowoff cock as required. When injector breaks, blow off steam through the steam heat line. When all steam pressure is off the boiler, start cold water through the injector with the top checks and maintain one-half glass with one blowoff cock open. Continue cold water until wrapper sheet is near temperature of washout water.

Important as even cooling down is, beyond any doubt the most damaging effect of hot blowdowns is the formation of distinct layers of baked on sludge caused by the evaporation of boiler water and sludge adhering to the flues and sheets. While not as hard as raw water scale it has well known insulating properties. Large sheets with firebox temperatures as high as 2,700 deg. and evaporation rates up to 90,000 lb.

of water per hour just will not stand up even with thin layers of baked-on sludge. Certain types of treated water bake on more sludge than others. Waters with well coagulated sludge and low dissolved solids seem to leave less scale baked on the hot metal. The damaging effect of oil in boilers is reduced by precooling. The reason is that sludge acts to absorb oil and any sludge baking on the metal acts as a carrier for the oil which then carbonizes on the hot metal. Carbonized oil is one of the best insulators known up to the present time.

The most frequent objection heard to precooling is that it takes too much time. But how many locomotives are tied up for patches and bolt replacement which should be in service? I have never heard that objection from railroads which are practising cooldown. Their locomotives are available except for about six to eight hours once a month. If other practices are as they should be, washing once a month is sufficient. During the hour to one hour and forty-five minutes it takes to cool the boiler such work as cleaning or replacing the brick arch, cleaning the combustion chamber and sump, blowing out or washing the flues, front end inspection and repairs to front end appliances can be carried out under much better and cooler working conditions. There is an actual time saving considering all the work done. The actual time for washing is less as little more than a rinse is needed as long as no part of the boiler gets dry. That is not the case with hot blowing.

Another objection heard is that precooling did not dry up stay or crown bolt leaks. The primary cause of bolt leaks is overheating the sheets and overheating is generally due to scale on the water side. The scale can come from poor water treatment or baked-on sludge. The evidence is ample and conclusive that precooling stopped leaks, broken bolts and cracks when no other cause for them could be determined. Precooling has also failed to stop them when the sheets have been permanently distorted by repeated overheating and uneven cooling.

Cooldown or precooling is not a cure all but it is an integral part of good railroading. It is a valuable aid to good boiler maintenance:—if the water treatment is good enough to prevent scale; if continuous blow is used to maintain good boiler water so frequent washing is not demanded; if a good steam conditioner is used to prevent foaming and subsequent reports for water changes; and if the boiler is washed out only upon inspection with no intervening water changes.

A circulation pump is not necessary but its use has many advantages. Draining a boiler with a circulation pump permits removal of washout plugs in barrel of boiler much sooner. Maintenance crews have the advantage of working in a dry pit where inspection to running gear, quarterly draw bar tests, stoker repairs and others can be made while boiler is being washed. In the winter time it is almost impossible to drain the boiler water into pits or sumps from the blowoff cock or plug holes without filling the house with steam and causing grievances, and unsafe working conditions. Draining the boiler rapidly with compressed air is effective but far too expensive.

The Duluth, Missabi and Iron Range Railroad has used the cooldown for years. Their large Mallets were never washed any other way except during a short period when they were leased to other railroads. These powerful 2-8-8-4 locomotives are among the largest ever built and are used for hauling ore from the mines to the ore docks. With good water treatment and cooldown I know of no repairs that have been made on these boilers except to comply with the I. C. C. rulings.

Most railroads who give this matter any thought at all usually prescribe two hours or more as being required to reach operating pressure in order to heat the boiler uniformly and avoid too great expansion strains. Blower lines may be bushed down in certain cases to give only enough draft so that the correct amount of time will be used in firing up.

In certain very large boilers, steam jet circulating devices are required to insure that cold water can not stratify in the lower parts of the boiler at the same time when full pressure and temperature is reached in the top part of the boiler. Individual railroads should investigate such requirements as the variation in type of fuel used, whether or not direct steaming is used, fire lighting equipment, and other such differences which make it difficult to make a recommendation except in very general terms.

The committee was unanimously of the opinion that the cooldown method of boiler washing should be adopted generally to improve boiler operation and thus reduce maintenance costs and improve the reliability of operation of the steam locomotive.

The members of the committee were H. R. Barclay (chairman), general boiler inspector, Northern Pacific; Carl A. Harper (vice-chairman) general boiler inspector, Cleveland, Cincinnati, Chicago & St. Louis; F. E. Godwin, mechanical inspector, Canadian National; A. A. Edlund, assistant general boiler inspector, Chicago, Milwaukee, St. Paul & Pacific; A. F. Robersen, district boiler inspector, Great Northern; R. V. Lucas, service engineer, National Aluminate Corporation, and V. A. McCoy, chief engineer, National Aluminate Corporation.

Discussion

After using the cool down method for over four years a 240 lb. pressure 4-8-4 was black throughout. In a typical cool down procedure, the locomotive was brought in the house at 205 lb., and the boiler filled by the injector through the overhead check. This was started at 11:15 a.m., and by 11:35 a.m. the boiler was filled above the water glass by the injector. The injector continued for 25 minutes until the pressure was reduced to 25 lb. A circulating line was attached to the delivery line through the top check and a circulating pump used for 15 minutes, during which time the pressure was reduced to zero. The boiler was filled with 120-deg. water from the washout plant. Seven minutes later the boiler was completely filled, and allowed to cool for five minutes. The boiler was then drained with a suction pump. When the water had receded out of sight of the glass, the boiler was inspected and washed over the flues and crown sheet. By the time this washing was completed the boiler was empty, and the flues and crown sheet had been washed. The total elapsed time for the pre-cooling and all washings took four and one-half hours.

The Northern Pacific is going to the cool down procedure on industrial boilers. Some now go 90 days between washings, while the newer ones go six months between washings. One boiler in an outside industry has not been washed since 1943. Several members thought that the 30-day requirement for boiler washing could be extended.

The Canadian National has had no appreciable fire box trouble for 20 years. Whether this was due to the precooling or to water treatment is not known as both were started at the same time.

A member criticized some methods used in pre-cooling. When the water enters through a side check, cold water hits the side sheets. When put into the top check and taken out through the bottom blow-off cock, cold water also hits the side sheets. Both inlet and outlet valves are located on the top check; therefore the best practice is to let the water go both in and out through the top check. Following this practice on one road has resulted in no trouble on locomotives up to 25 years old, which are those put in service since this procedure was adopted.

The Bessemer & Lake Erie has followed the cool down system for less than two years but has much praise for it. Ten years ago pyrometer checks were made which showed considerable damage from rapid firing, but greater movement occurred in the cooling down process.

Advantages of Top Spray Boiler Checks

K. D. Relyea

By K. D. Relyea
Test Department, New York Central

The patching and renewal of firebox side sheets has been a major item in boiler maintenance for many years and has been a subject of intense research by the members of this association. The experience of the New York Central has not been materially different from that encountered on other roads. It had been necessary to renew firebox side sheets at every shopping period and a large number of our locomotives have had to receive large patches between shoppings.

In the years 1940 through 1944 we accepted delivery of 115 new 4-8-2 locomotives, the majority of which were for combination freight and passenger service. One locomotive of this class, after accumulating approximately 28,000 miles of service since construction, developed wavy side sheets and leaking bolts. Several others required patches well under 100,000 miles and practically all required new sheets at approximately 120,000 miles.

Metallurgical examination of many sections of these failed sheets usually revealed the same result—namely that the failure was due to fatigue cracks, particularly in the fire region.

These side sheets were purchased by the A. A. R. M-115 specifications for firebox steel. We went back to the original analysis of the steels, the inspection reports, water treatment, washout practices, the method of making the staybolt holes and cylinder and feedwater pump lubrication practices, all in an effort to determine, if possible, wherein lay the answer to these failures.

Three courses of action were decided upon: (1) The reduction of the amount of oil to the boiler by the strict regulation of the mechanical lubricators and the removal of the feedwater pump exhaust from the heater to the atmosphere on five locomotives; (2) A trial application of alloy steel firebox side sheets, and (3) A trial application of a top boiler check and spray nozzle.

It was felt that these three approaches to the problem would yield the answer as to whether it was oil deposits in the boiler, firebox steel or cold water entrance into the boiler.

The reduction of oil to the boiler gave some indication of improvement but was not the answer as patching and renewing of side sheets continued.

The application of alloy steel side sheets was made to alternate sides of 10 locomotives with the opposite sheet of standard A. A. R. M-115 steel. Four applications were made of manganese-vanadium to ASTM A-225-39T, Grade A, three carbon-molybdenum to ASTM A-204-42, Grade A, and three of Mayari R Bethloc steel. Three of the ten were also equipped with the top boiler check and spray nozzle to obtain comparison with side check performance.

Three applications are still in service and are those equipped with the top check. The other seven alloy sheets, as well as the companion M-115 sheets have all been removed due to cracks at the staybolt holes. Metallurgical examination of the sheets indicated the steel to be of good quality but again failure was due to fatigue. The minimum mileage was 83,000 miles and the maximum mileage 155,000 miles. To date, the three top check locomotives have accumulated approximately 250,000 miles with all sheets in excellent condition and no noticeable difference in performance of the alloy sheets or the standard steel. It may be when the sheets are finally renewed, we may find some advantage to the alloy steels.

The object of the present applications was to positively assure that no relatively cold water could enter the boiler. It is characteristic for fireman to control the boiler pressure by the use of the feedwater pump and in cases when the locomotive is shut off quickly after heavy evaporation the pump is usually put on full. In the case of open type feedwater heaters this permits a large volume of cold water to enter the boiler at the time the firebox is at its greatest heat. As cold water will drop to the bottom and circulate along the hot side sheets there probably exists as much as 200 deg. difference in the temperature between the top and bottom of the sheet. This situation causes continual changes in stress and leads directly to fatigue.

With this thought in mind it was decided again to try a top boiler check application except this time a spray nozzle was incorporated to diffuse the water. The spray nozzle used was designed by the Worthington Pump and Machinery Company for use with their heater applications.

The first application was made on January 13, 1944. The locomotive was not selected but was one undergoing repairs at West Albany, N. Y., Shops. This particular locomotive was built in December, 1942, and had accumulated 138,000 miles prior to this shopping. New side sheets of M-115 steel were applied at the same time the top check was applied. This locomotive was shopped again in June, 1945, and May, 1947, under Class 4 repairs. The only firebox repairs necessary were a few scattered staybolt renewals. It was last shopped in June of this year, at which time it was necessary to apply quarter side sheets on both sides. (The usual size has been ¾ sheets.) The total mileage between firebox repairs was 485,416 miles. This may be exceptional but several later applications are fast approaching this record.

Analysis of the boiler history of 65 locomotives of this class show a great improvement in firebox maintenance since application of the top check and spray nozzle. E. H. Heidel in his Study of Defects in High Pressure Boilers (*Railway Mechanical Engineer*, November, 1942, page 450) indicated six years of service for new sheets after application of top check and much of our data is bearing this out.

Of the 65 records analyzed, nine locomotives have received side sheet repairs at the first shopping period of approximately 140,000 miles after application of top check. Six of the nine are assigned to a specific territory of 200 miles and indications are that the cause of short life was due to faulty washout practice which was corrected upon discovery.

The complete boiler history of a typical locomotive prior to the application of a top boiler check exemplifies the results of the top check application.

Locomotive No. 3034, built January, 1941, had new side sheets in November, 1942, after 131,000 miles, new side sheets in July, 1944, after 100,000 miles, patches on both sides in February, 1945, after 39,000 miles, patched again in September, 1945, after an additional 26,000 miles, patched again in May, 1946, July, 1946 and January, 1947, each period being approximately 25,000 miles. The locomotive was finally shopped in January, 1947, when it was necessary to renew the sheets again. In a total of 366,000 miles with the use of side boiler checks the side sheets had been renewed three times and patched five times. The locomotive has accumulated 112,000 miles since the application of the top check with no firebox repairs whatever.

Of this group of 65 locomotives, 31 have been through one shopping and five through two shoppings without side sheet repairs. Two have exceeded 400,000 miles, four have exceeded 300,000 miles, 21 have exceeded 200,000 miles and 28 have exceeded 100,000 miles.

To date, we have applied top boiler checks and spray nozzles to approximately 500 locomotives. The same check has been used that was used for the side application and the spray nozzle has been welded to the steel ball ring. The nozzle assembly is fabricated at our shops in accordance with Worthington sketches. It has been necessary to relocate the sand box on some classes in order to locate the check in proper relation to the outlet of the dry pipe. The check has been located in the first course on top center. Deflector plates are necessary to keep the water from spraying directly upon the dry pipe.

As a large steam space is best adapted to top check applications some difficulty may be encountered in small boilers by the raising of water.

We have encountered complaints of water carry-over on our J-1, 4-6-4 class and have installed baffles in order to reduce this tendency. The J-1 has 143 cu. ft. of steam space compared to 165 to 267 for other classes thereby making the condensation of steam more critical. In effect, a top check application makes it necessary for the locomotive to increase its rate of evaporation to compensate for the heat given up by the steam to the feedwater. Locomotives with ample steam space will not encounter such difficulty.

The advantages of decreased firebox maintenance justifies the application of a top boiler check and spray nozzle to all classes of steam locomotives that are subject to repeated failures of their side sheets.

Modern Boiler and Firebox Steel

In 1921 it was stated in this country that there has been little or no work done on which the rational mechanical treatment of elevated temperatures can be based. The effect of raising the temperatures on the properties of metal cannot as yet be stated in terms of any definite law; at present it is necessary to treat each class of materials separately. It is necessary then that technological tests of materials to be used in boilers be continued since the plates are not only used at elevated temperatures, but they are weakened by being perforated with rivet holes.

The realization for the need of such studies improving boiler construction was well expressed by R. Baumann, a German research worker, as far back as 1922. The work reported on was completed in 1914. One of Baumann's points of summary bears repeating at this time. "On driving a rivet the plates are stressed over an extensive area as far as the adjacent holes. Consequently, when multiple riveted joints are used the metal at each rivet hole is subjected to repeated stress reversals which as is known very materially lowers the toughness of the plate. A further injury may result when the plates become warped as a result of high riveting pressures. On driving adjacent rivets, the plates are again forced together. This is also the case in caulking the seam, all of which results in stress reversals. It is evident that abusive handling of the plates is not permissible; such abusive handling may occur in fitting the plates, etc. In general it may be stated that careful workmanship, such as the removal of chips and burrs between plates, the production of properly shaped and properly seated rivet heads, proper care to make rivet holes register, etc., is essential to preserve the plates in good condition and to prevent, in so far as possible, overstrain of the material. Careful workmanship in this respect is of great importance in highly stressed joints, and especially those which, in service, are to be subjected to high temperatures and considerable temperature fluctuations."

Workmanship in boiler construction and repair is of major import. In examinations of failed specimens of firebox and boiler steels during the past year, steels which represent failures on A. A. R. member roads throughout the country, improper workmanship seems to reflect itself more and more in boiler and fire box failures. It is a fortunate circumstance that this factor, more than any other, is readily controllable when so recognized and properly evaluated.

Special studies have been made of test ingots of various analysis to determine resistance to aging and blue brittleness. The test ingots of varied analysis were made in a 100-lb. induction-type furnace. From the top position of each ingot sufficient bar stock was forged for Jominy tests for hardening qualities. The balance of each ingot was then forged into 2 in. by 5 in. sheet bar stock and then rolled into ⅜ and ½ in. plate stock.

Special steels were made to selected analysis for the purpose of determining the effects of additions of alloying special deoxidizers, other elements and of reduction in carbon and manganese content. Copper was added to three steels in amounts over .50 per cent because copper as a residual had been questioned and to determine what beneficial effects might arise from the use of copper as an alloying element.

Phosphorus was added to five of the steels in amounts above .09 per cent to determine if there were any deleterious effects. Silicon was added to six of the steels in amounts varying from .25 per cent to .45 per cent. Beryllium was added in small amounts to two of the steels. The special deoxidizing agents in addition to aluminum were titanium, zirconium and columbium.

The investigations showed blue brittleness associated with all the typical specification steels (A. A. R. and A. S. T. M.) firebox and boiler steels, carbon and alloy grade.

In testing at elevated temperatures, plotting the curves, tensile, yield strength, elongation and reduction of area versus temperature, blue brittle tendencies are manifest by an increase in tensile and yield strength, a decrease of ductility (elongation, reduction of area) at critical temperatures 400 deg. to 600 deg. F.

The rate of precipitation of carbides, nitrides or possible oxides at slip planes during straining increases with the increase of testing or operating temperature.

The phenomenon of aging of firebox and boiler steels appears to be closely associated with that of temper brittleness. A tensile test through the blue brittle range is the quickest way found to date of distinguishing between a non-aging and an aging steel. These steels in addition to being predicted as aging steels are also susceptible to blue brittleness.

On steels removed from service at room temperature tests, aging is manifested by an increase in ultimate and yield strength and loss of ductility when compared with the original physical tests or tests of unused new materials.

Analysis of failed materials during the past few years has been made for the purpose of determining the effect of residual elements in the steel. The residual elements may be defined as those elements occurring in the finished products which are not deliberately added, but are picked up from

scrap or other sources. These elements have been present in firebox and boiler steels for many years as the analysis of some failed materials shows.

This report was presented by a committee of which Ray McBrian, engineer of standards and research, Denver and Rio Grande Western, was chairman.

Effect of Residual Stress In Boiler Failures

There are several simple considerations of the physical properties of boiler steel, the understanding of which will lead to realization of what must be done to prevent failure.

1.—Failure in this discussion is to be defined as the development of a crack or cracks in the steel of such a nature that disastrous consequences would result if the boiler remained in service.

2.—Such cracks are formed and develop only in areas stressed in tension, and the crack is always at right angles to the direction of maximum tensile stress. This concept is of the utmost importance.

3.—Stress to produce such cracks can be either residual, induced by service, or both. The effects of each class are additive.

4.—Steel is not a homogeneous material, and its physical properties, over both large and small areas, vary with varying directions.

5.—Steel is not a stable material, and strain or distortion in localized areas in conjunction with high temperature may produce added straining influences.

6.—Intergranular corrosion will not start nor progress in areas subjected to compressive stress.

7.—Measurement of strain or deformation in one direction only is not sufficient to define the stress condition, because when steel is stretched in one direction, transverse dimensions shrink. The ratio between these perpendicular dimension changes is known as Poissons Ratio, which for steel is about 0.28.

8.—Stresses in two or three directions at right angles to each other produce more disastrous consequences than simple one-directioned stress. In boiler construction and operation, we always find appreciable stress in at least two directions, and in some areas three.

Residual stress may be thought of as a condition in solids such that, if a portion of the solid is carefully removed, the remaining portion changes shape or dimension. This fact offers a convenient means of determination of residual stress. Since the work piece must be of such a size that it contains innumerable grains or crystals of the material, each having directional properties and random orientation, the net directional components of all the stresses present are measured. The assumption that residual stresses are uniform throughout the piece, both as to direction and magnitude, is not necessarily true, and will deviate more with increasing complexity of the geometry and working of the piece.

There are several ways in which residual stresses are induced into a piece, but all of them include plastic deformation of portions only of the piece. Obviously, if the entire piece has been plastically deformed, uniformly in amount and direction, there can be no residual stress; but since steel is not homogeneous, micro residual stresses will be present in such amounts that the sum of all components equals zero in any direction.

We are now concerned with methods of boiler fabrication which induce damaging residual stress, and means of offsetting their effects. In general there are two fabricating steps which induce residual stress, cold rolling of the sheet, and machining it. If a strip of steel is bent slightly and released, it assumes its original shape. If bent more, it retains a partly bent shape, and residual stress of a value slightly below the yield point of the material is present, in the outer layers. Since the convex side of a boiler sheet is in tension, cracking will proceed in the laps, other conditions suitable. The cure for this would be to shotblast the convex surface in the lap area to put it in compression.

The other method of fabrication which induces residual stress is machining, including drilling, reaming and grinding. It is standard practice to ream rivet holes, but the reamers are never as sharp as they should be. Consequently, metal is pushed around instead of being cut off, leaving tensile stress, which again allows intergranular corrosion.

Again the cure is compressive stressing, which can be done by shot blasting, or simpler, merely driving an oversized pin through the finished hole. Recently a rotating heater has been developed for this purpose, where a hammer slightly smaller in diameter than the hole is driven at high rotative speed by an air gun with eccentric balance in the rotor. The machine is merely run through the hole, and the job finished in seconds.

Grinding is probably the method of fabrication to which the least amount of thought has been given. Three damaging actions can take place. The cutting edges in a grinding wheel are merely tool points which are improperly shaped, for clean cutting. A coarse wheel digs furrows in the metal, pushing it at right angles to the direction of wheel travel. Here the residual stress is compression in the peaks and tension in the valleys. Since the valley is an effective stress raiser, any operating stress is multiplied by an appreciable factor. A dull, loaded wheel will push metal ahead of it, leaving residual tension and possibly torn metal. The third action is burning, which leaves damaged metal. The answer here is to be found in consultation with an expert on grinding, to find the proper wheel for the job, and in a high degree of training. Similarly, ground areas should be shot blasted, to put the surface in residual compression.

Since these various damaging actions take place in almost any direction, and since the operating stresses are in variable direction, especially of riveted joints, the resulting stress pattern is truly complicated. Naturally, if induced residual stress, direction of stress raisers, and operating stress all line up in somewhat the same direction, the result is disastrous.

The idea of shot blasting to produce residual compression was presented last year at this meeting so no new principle has been offered. However, there are some ramifications which should be emphasized.

Some remarkable results have been obtained, particularly in the automotive industry by compressive stressing, and there have been some unexpected failures. A little thoughtful examination of the failures in most cases pointed out their cause. If a machine part or structure is loaded during operation in compression, an induced residual compression may lead to such a high value that plastic deformation takes place. Then upon release of the load, a tension stress is formed, leading to failure. Consequently, shot blasting cannot be used indiscriminately to cure all evils.

In all sections, if compression is induced at one point there must be a balancing tension formed at some other location, and especially in thin sections, the value may be high enough, coupled with operating stress, to cause failure. This is especially true in carburizing or nitriding thin sections subject to bending stress. The failure in this case originate somewhat below the surface, always at the point of highest net tension with respect to the load carrying capacity of the material involved.

The maximum benefit to be derived, in such parts as airplane and automotive work where size is important, is found where, on long time testing, half the failures start at the outer surface and half start below the surface.

Of course, unexpected inclusions or other lack of homogeneity in isolated parts upsets all calculations.

This discussion of automotive work has been given to emphasize the immense benefits which have been obtained, and predictions are, of course, that benefit can result in boiler practice. However, some investigation and thought must be applied so that unsound practice will not be instituted.

The concept of pre-stressing to prevent failure is exceedingly simple, efficient and easy to apply.

This part of the report was submitted by Walter Leaf, research technician, Denver & Rio Grande Western.

Discussion

In 1930 the Santa Fe put into service some nickel steel boilers with carbon steel rivets. To date there has been no trouble with these boilers. In 1938 more nickel steel boilers were put into service, this time using nickel steel rivets. Trouble occurred in less than two years. When the nickel steel rivets were replaced by carbon steel rivets, no more trouble was experienced with rivets.

The Canadian Pacific has a number of alloy steel boilers built as far back as 1938, and these have not cracked. Some, built during the war, have cracked.

C. N. Loeffler, Alco Products Division, American Locomotive Company, said that the suitability of a material for locomotive boiler service includes such considerations as oxidation and corrosion resistance, tensile strength and fatigue strength. A wide range of oxidation resistance exists between the carbon and low alloy steels on one hand and the high alloys on the other. It is generally true however that strength considerations govern except in the case of non-pressure parts. Corrosion resistance is not too important a factor in selecting carbon or low alloy steel, but in itself is a serious problem and water treatment must be relied upon to minimize failures. Low chrome-moly steels are not recommended for welded boilers as their air hardening characteristics promote cracking, and preheat and postheat treatment is required. Nickel steels and manganese-vanadium steels offer no difficulties to welding.

Staybolt Application and Maintenance

[This group of reports comprising a general topic under the subject of staybolt application and maintenance was made up of four sections, as follows: (a) staybolt threading standards; (b) application of staybolts; (c) seal welding of staybolts, and (d) the maintenance of staybolts. The individual reports of the members of the committee are presented under the above groupings.—Editor.]

Unified British-Canadian-American Screw Threads

The declaration of accord concerning the unification of screw threads signed by the various representatives of British, Canadian, and American government agencies, technical societies and industries is not in the nature of a contract. No railroad company or manufacturer is bound by it. A manufacturer of threaded parts, or of equipment containing such parts, may not choose to change over to the unified form of thread. This may or may not injure his business, depending upon the particular application of his product. Even if a manufacturer does change over to the unified thread, some of his customers may not take the product. This is apt to be so in cases of the higher classes of threaded products wherein the fits are closer. Threads pertaining to the application of staybolts may be considered as belonging in this grouping, and this may slow down or indefinitely postpone the changeover to the unified thread as far as the commercially operated railroads are concerned.

In the process of unification, compromises have been made by all three of the countries which are signers of the accord. The major change in the U. S. standard form of threads, in converting to the unified form, consists of a rounding off of the truncated portion at the root of the external thread. The peak of the external thread is changed but little. The outside diameter, however, is slightly reduced so that it will not "score" into a Whitworth nut.

The next in importance in the change-over from U. S. to Unified thread, is applicable to the lower numbered classes of fit (1 and 2) only. This is the change in the "allowance" as distinguished from the "tolerance." The allowance is the planned looseness of fit between the mating parts. The allowance is taken care of mainly in the external thread, i. e., in the bolt.

In classes of fit numbered 3 or above, there is no "allowance," so this factor does not affect the threading of staybolts in the U. S. A., since this is being set up by the M. B. M. A. as a close 3 fit.

In the Unified screw thread, the classes of fit are given numbers corresponding to the U. S. Standard numbers (Class 1, 2, 3, etc.) but these numbers have the letters A or B added. A, refers to external thread forms; B, to internal thread forms.

In staybolt threading, the change-over to the new thread would therefore involve changing from Class 3 to Class 3A. The tapping of sheets and KN nuts would come under 3B. In addition to the changes in form mentioned above, the tolerance of the staybolt thread will be increased by 0.0004 in. From the point of view of making and assembling, this is an advantage, except that in some boiler shops the workmen are already making use of this extra leeway and in a few cases, even more. In line with what I have mentioned above concerning external thread tolerance, the internal threads in boiler sheets and in KN nuts will also have a greater advantage from the standpoint of manufacturing and assembling, as the tolerance for the 3B thread will be increased under the unified thread specification by 0.0017 in.

The change-over would require that boiler shops and staybolt makers buy new chasers and taps. This would mean an extra investment as it would be necessary to stock the old as well as the new for some time to come. New gauges would have to be purchased. Some adjustable gauges could be reset for the new standard, but, here again both old and new would have to be carried.

There should be no increase in cost of direct labor in making and applying staybolts with unified threads, but there might be an increase in the setting-up costs, in manufacturing, on account of more frequent change-overs.

The evidence is strong that government orders may soon come through with the unified thread specified and it may not be very many months before all defense items ordered for the newer types of equipment, by the Army, Navy and Air Forces, will call for the unified thread.

The urgency, in case of a threat of war, is not only on account of the advantage of interchangeability but also in the speeding up of the assembling of parts where high speed "wrenching" is applicable.

A number of the manufacturers of threaded parts are already making plans for changing over to the unified thread standard. One manufacturer has estimated that his company would complete the change within two or three

years, when and if it becomes necessary. Another manufacturer has stated that he is setting up a five-year change-over plan for his company with an "allowance" of two years more.

This report was submitted by Dr. G. R. Greenslade (chairman), director of research, Flannery Bolt Company.

Application of Staybolts

No standard specifications covering joint sealing compounds have been set up by the Mechanical Division of the Association of American Railroads. The question is therefore left to the judgment of each locomotive equipment manufacturer and operating company.

A little extra thought to joint sealing problems will increase the efficiency of equipment, save hours of repair time and reduce the costs of replacement parts. In spite of improvements in thread cutting tools and machinery, no two pipe joints, studs, or bolts are cut exactly alike. Male and female threads are cut with separate tools. An allowance or tolerance is established to secure a "perfect fit." When the pipe joint, stud or bolt is assembled, a jamming action results. The friction generates heat. If the temperature created is high enough, the metal parts tend to fuse. Galling and seizing may also take place.

Many types of joint sealing compounds have been developed for the purpose of sealing joints tight against leakage. Among these are combinations of oils, grease, soaps, gums, clays, molasses, graphite, powdered zinc or powdered lead. If a compound eliminates leakage then it is a good joint sealing compound.

To be an anti-seize compound also, the joint sealing compound must have additional properties. A compound which reduces the torque required to break out a pipe joint, stud or a staybolt is called an anti-seize compound. The torque required to disassemble should not be more than the torque required to assemble.

When a locomotive is built it is known ahead of time that many pipe joints, studs, etc., must be disassembled periodically for cleaning or other service work. Some joints are considered "permanent" but even these may be the subject of action by a man with a wrench at some future date. A proper joint sealing and anti-seize compound which will keep the joint sealed or the stud or staybolt tight while in service and which will allow the joint, stud or staybolt to be disassembled easily when desired is therefore of definite value.

In putting in staybolts there is a tendency for the sheets either to expand or contract. Riveting is hard on a staybolt; it also has a tendency to fracture and dish the sheets since they are loosely assembled by either wrenches or hammers. Not knowing the amount of power that is being used has a tendency to do two things,—dish the sheet and stretch the bolt.

All staybolts or other threaded assemblies should be assembled with a torque wrench. Then if a suitable anti-seize joint compound has been used, all chances of stripping and fracturing would be eliminated as this type of lubricant would cause the metals to flow without fracture. In using any other type of lubricant it would have a tendency to pile up and gall. On hollow staybolts the staybolt should be inserted with a lead compound. Then the hole should be expanded with a tapered pin so that it would seal itself in the hole from the inside rather than to peen it from the outside. There are tools on the market by which the portion on the outside of the sheet could be rolled by the same tool which would have a tendency to make a nice, clean job and look a whole lot like a button.

In inserting a flexible staybolt the application of a leaded compound in the ball and socket, including the copper gasket, would not only make a more flexible seal and allow freer movement of the bolt, but would help to eliminate fracture of the sheet. The use of the leaded compound will eliminate corrosion and keep it free so it could be knocked out at any time easily.

This report was submitted by I. H. Grancell, president, I. H. Grancell Company.

Seal Welding of Staybolts

Locomotive 834—4-8-4 type passenger carrying 300-lb. working pressure—was given a new pair of side sheets during Class 3 repairs April, 1946; all staybolts were seal welded before releasing for service. This locomotive was again shopped for Class 3 repairs March 1948 after making 330,080 miles. No side sheet or bolt work was necessary. To this date Locomotive 834 has made approximately 230,000 miles in the second term of flue mileage and side sheets are estimated to be good for an additional 100,000 miles. Previous performance: side sheet patches at 150 to 175,000 miles and renewal of full side sheets at approximately 300,000 miles.

Locomotive 804, another 4-8-4, carrying same working pressure, received Class 2 repairs March 1947 at which time all staybolts and crown stays were seal welded. This locomotive, shopped for Class 3 repairs January 1949, had made 283,000 miles with no side sheet or staybolt work necessary. It has made to date 110,000 miles in its 2nd term flue mileage and fire box sheets and bolts are in good condition.

The 3800 class 4-6-6-4 type locomotives referred to last year are both still in their first term of flue mileage having made approximately 200 to 225,000 miles and will require shopping in the near future. Fire box sheet renewals are not anticipated. However, staybolt performance has not been as satisfactory as in the passenger locomotives as it has been necessary to renew a few bolts from time to time because welds broke away from the staybolt heads. One of these locomotives is equipped with iron bolts, the other with steel bolts and the performance has been approximately the same in both locomotives. However, we still consider the performance of staybolts in these two tests satisfactory as in spite of necessity of renewing a few bolts, there has been less leakage and no sheet work necessary. We contribute the defects which have developed to the fact that these large oil-burning freight locomotives are subject to severe service and terminal abuse.

Bolts are applied from the outside where possible, set at not less than two full threads for heading, properly backed up with a 60-lb. dolly bar and driven with standard tite staybolt driving snap with a 60-lb. or 80-lb. air hammer.

Cleaning ends of bolts and sheets is very important, and we follow the practice of applying coat of whiting to sheets and bolts to absorb the oil. After the whiting dries, a steel buffing brush is used to remove the sediment and, where oil is drawn to the surface of the sheet while welding, it is burned off with acetylene torches. The fire side of all sheets are sand blasted before applying.

Seal weld bolt heads with a ⅛-in. reverse polarity welding rod, starting the weld on the side bolts at the top center, welding down to bottom center, then clean starting and stopping ends of all flux and complete the welding from top downward. On the overhead bolts start the weld at any point and weld a continuous full circumference.

This report was submitted by E. E. Owens, general boiler inspector, Union Pacific.

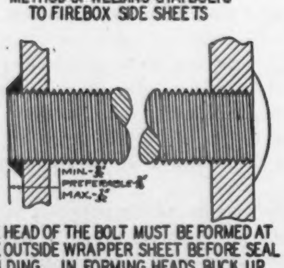
The Results of Seal Welding

When boilers with pressure ranging from 250 lb. to 300 lb. were put in service, leaking staybolts and cracked side sheets became quite a problem, and not only reduced the side sheet mileage considerably, which was as low as

approximately 80,000 miles between renewals on a number of locomotives in certain territories, whereas in other parts mileage as high as 500,000 was not uncommon, but also the availability of the locomotive use was greatly reduced due to the fact that it was continually being held out of service to make necessary repairs to side sheets and staybolts. These defects would generally start after about 30,000 miles service.

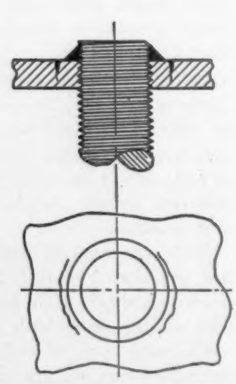
In April, 1944, we decided to try seal welding of staybolts. Two Mikado locomotives, boiler pressure 275 lb., were put in the shop for right and left side sheet renewals and the solid staybolts were seal welded as in the drawing. Starting at the first row above the grates and extending upwards two-thirds of the height of the sheets, no flexible bolts were seal welded. One locomotive had staybolts seal welded on the right side, and staybolts on the left side were batted up in the usual manner; the other had seal welded bolts on the left side, and staybolts on the right side batted up in the usual manner. The locomotive with the seal welded bolts in the left side was shopped in April, 1949, and had accumulated 455,530 mi. since the application. No defects were found, no bolts have leaked and no cracks have developed in either side sheet during this mileage. The locomotive with seal welded bolts in the right side was shopped in April, 1949, with an accumulated mileage of 449,324 since the application. While we experienced no trouble with bolts leaking or cracks developing in the right or left side sheets during this mileage, inspection of the sheets at the shop disclosed that cracks were developing from the bolt holes on side sheet with the seal welded bolts and it was necessary to apply a fairly large patch to remove the defective area, while the side sheet with the bolts batted up in the usual manner was still in good condition and no repairs were required.

METHOD OF WELDING STAYBOLTS TO FIREBOX SIDE SHEETS



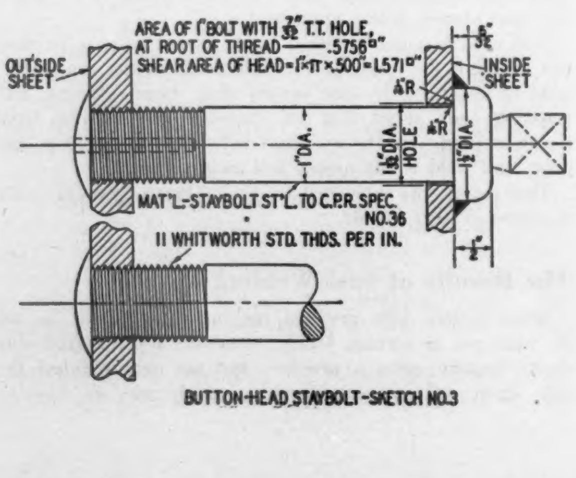
THE HEAD OF THE BOLT MUST BE FORMED AT THE OUTSIDE WRAPPER SHEET BEFORE SEAL WELDING. IN FORMING HEADS, BUCK UP INSIDE OF FIREBOX IN USUAL MANNER. THE BOLTS AND SIDE SHEETS SHOULD BE CLEANED FOR GOOD WELDING. START WELD FROM THE BOTTOM, WORKING UP BOTH SIDES. PEEN WELD DEPOSIT LIGHTLY TO SEAL PIN HOLES.

SKETCH NO. 1



CRACKS DEVELOPED IN SHEET, FRONT AND BACK OF STAYBOLT NEAR WELD.

SKETCH NO. 2



BUTTON-HEAD STAYBOLT-SKETCH NO.3

After these two locomotives had accumulated approximately 100,000 miles we were satisfied with results obtained and decided to seal weld staybolts.

In 1944 we built some 250-lb. Pacific type locomotives. The second one turned out had 7/8-in. Monel staybolts in the left side and 1-in. steel staybolts in the right side; both sides were seal welded. This engine was shopped in July, 1946, with an accumulated mileage of 151,006. No defects were found and no leaks or cracks had occurred during this mileage. This locomotive was again shopped in February, 1948, with an accumulated mileage since the application of welded bolts, of 272,015. While no leaks or cracks between bolts developed during this mileage, the inspection of the fire box at the shopping disclosed cracks developing in the right and left sheets following the edge of the weld front and back of the bolts and in a number of cases the crack had developed all around the bolt. Sketch No. 2 (see illustration) shows location of cracking. There was a definite indication that the crack started at the front and back of the bolt. This cracking covered a large area of both sheets, but more severe in the centre of the sheets. Both sheets had to be renewed, and 1-in. steel bolts were applied and batted up in the usual manner. The finding of this condition caused us to discontinue seal welding of staybolts for the time being, until we see what develops in the other fireboxes that have seal welded bolts.

We are now experimenting with a 1-in. button head staybolt in the side sheet on a Pacific-type locomotive with boiler pressure of 275 lb. This bolt has no threads for the firebox sheet; it is threaded only for the outside or wrapper sheet and the button head is seal welded to the side sheet. Sketch No. 3 of the drawing shows the bolt design and the method of application. Forty-two of these bolts were applied in the center of the right side in the location where all the severe cracking and bolt leakage develops.

Some time ago we made tests to determine the pull-through load value on parallel thread stays, tapered stays and button head stays in an overheated sheet.

There was such a vast difference in the load of the button head bolt over the parallel threaded or tapered thread bolts that we decided to make a test of 1-in. button head bolts. Tests were made in the following manner: no thread at the button head end, threads only in the outside end; seal weld some button heads and not seal weld the button head on others. The seal welded head failed at a maximum load of 7,350 lb. and the non-seal welded head failed at a maximum load of 6,710 lb.

The result of this test and the general belief that the sharp edge of the thread in the sheet is where the cracks start from and that thread is a large contributor to the cracking of side sheets caused us to experiment with 1-in. button head staybolts with no thread in the side sheet and seal weld the head. These bolts have now accumulated 98,000 mi. and show no indication of leaks or cracks developing in the sheet and the button heads show no indication of being overheated.

We have been experimenting along the lines of the late Mr. Huston's idea (International Nickel Company) of reducing the size of staybolts to increase their flexibility. In 1946, when we were building new Pacific type locomotives, pressure 250 lb., we applied 15/16-in. dia. Molybdenum steel staybolts to ten of these boilers in the following manner: Five boilers have 15/16-in. Molybdenum steel staybolts applied to the right side sheet and our 1-in. ordinary steel staybolts to the left side; five boilers have 15/16-in. Molybdenum steel staybolts applied to the left side sheet and 1-in. ordinary steel staybolts to the right side, for comparison purposes. So far we have not found any broken bolts of either material in these boilers.

This report was submitted by F. R. Milligan, general boiler inspector, Canadian Pacific.

The Maintenance of Staybolts

All heating surfaces should be thoroughly cleaned for scale and oil. We sand blast crown sheets on the water side and around crown bolt connections at the crown sheet, also down the radius of the crown as far as possible. This is accomplished by wet sand blasting which has, to date, proved a sound investment, especially on boilers that have a silica scale deposit on the heating surfaces of the crown sheet.

Staybolts that show signs of leakage or pulling away from the sheet are re-driven by the double hammer process; otherwise these are not touched. Boilers that receive heavy firebox repairs and are contaminated with oil are boiled out before leaving the main shops. At present, we are removing the tender tank oil skimmers in favor of a new type oil separator. Removing the oil from the exhaust steam as it leaves the cylinder in an atomized state will eliminate the plugging up of condensate pipe lines, and keep the copper tubes in the feed water bundle clean, which will increase the efficiency of the heater.

Large power is being equipped with automatic continuous blowdown (surface). The blowdown discharge is taken from a few inches below the surface of the water adjacent to the dome. Comparative tests of boiler water taken from surface blowdowns and regular blowdown proved that the sample taken from the surface blowdown carried a dissolved solid concentration of 5 to 10 per cent higher than the sample taken at the mud ring. This indicates that we are obtaining greater relative reduction in solids from the surface blowdown for the same volume of boiler water blown out. This surface blowdown working at the dome should help considerably in eliminating carry-over in the steam.

All boilers are equipped with top checks and wye-type nozzles which divert the water away from the dry pipe and boiler shell plate, eliminating as much as possible feedwater coming in contact with the metal. When firebox side sheets are being renewed, staybolt holes in the wrapper sheet are gauged and if found to be 1⅛-in. diameter, reduced by counter-sinking and welding the soles solid, then redrilling for 1-in. staybolts. We have found that this method is more economical than renewing the outside wrapper side sheets. Care must be taken when tapping welded holes, as these holes invariably are a hardened metal and will destroy the best taps and staybolts will be hard to fit unless proper reaming is done before tapping is commenced.

Little research work has been done by us on seal welded staybolts on account of initial tests in 1945 proving unsatisfactory. Two boilers had right side sheet staybolts seal welded, but both left side sheets were standard application non-welded type. After 36 months' service, seal welded bolts became defective on both boilers; non-welded side sheets are still in good condition after 48 months' service.

Two other boilers had staybolts seal welded in the right and left side sheets; the side sheets were in good condition on both after 44 months' service. On the above tests the staybolts were not hammered up on firebox side, only bucked up on the inside when driving bolts on the outside. The latter two locomotives showed a considerable improvement over the previous two applications. No further applications were made in 1947 or 1948.

In view of the improved electrodes available on the market this year, in the E-6015 class, low hydrogen electrode with 70,000-lb. per sq. in. tensile with a much higher ductility, we attempted another application of seal welded staybolts to prove the merits of this new electrode. We have welded a righ-side application with E-6015 and left side sheet with the ordinary E-6010 class rod. On this application, we double-gunned all staybolts, inside and outside, and applied a hydro test to the boiler to insure tightness before the staybolts were seal welded. One-eighth inch electrode was used with the weld commencing at the bottom and up to the top center. It was recommended to peen this type of welding when completed to release any locked-up stresses and bond any porosity that existed in the weld. This application has only been in six months, there is no report.

Seal welding is not a positive means of eliminating staybolt leakage, but can only be effective to the extent of the accuracy in mating of the threads in the plate and staybolt. While we know this potential failure exists in all threaded applications, we should endeavor to eliminate this failure by advocating the development of the non-threaded fusion welded staybolt for locomotive fireboxes as the probable answer to this complex problem.

Cooling down boilers is gaining in popularity. Hot wells should be of proper capacity to take care of heavy wash-out programs. One of the most important jobs in any enginehouse is keeping boiler flues clean. A locomotive dispatched with dirty flues is false economy. The same applies to leaky or defective superheater units.

This report was submitted by F. E. Godwin, mechanical inspector, Canadian Pacific.

Discussion

One road that had difficulty with staybolts leaking in 1938 applied some seal welded staybolts to a number of locomotives. After 400,000 miles none of the seal-welded bolts had developed leaks, but those that were not seal welded continued to develop leaks. It was also recommended that the two-year removal requirement for flexible staybolt caps be extended to four years. Attention was called to the membership of objections to welded staybolts having an end that projects into the firebox as this end is subject to damage from cinder cutting and high firebox temperatures.

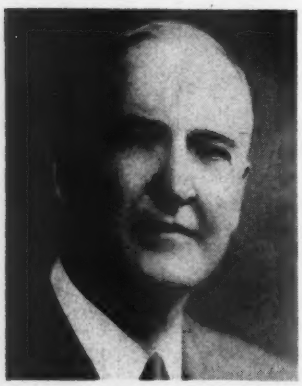
Seal welded staybolts performed better on the Santa Fe than others, but it was said that good water treatment was equally necessary with seal welding for good staybolt life.

H. L. Miller, Republic Steel Corporation, said that the Miller-Grant staybolt is designed to prevent failure of the joint between the staybolt and the sheet with a minimum of metal. It gives mechanical support to the plate by the bevelled head, and the weld seals the joint between the head and the plate. The results of comparative fatigue tests between the Miller-Grant bolt and the threaded bolt could be influenced in favor of the threaded bolt by stresses which cause the bolt to work loose in the plate and prolong the bolt life. In the Miller-Grant bolt the stress is concentrated and the bolt is much more rigid in the plate. Elimination of broken bolts as such is a small factor compared to preventing bolt failures in the joint between the bolt and the plate which causes side sheets to fail.

E. R. Hemberger, Baldwin Locomotive Works, discussed several things which affect the tightness and efficiency of threaded staybolt joints. The bolts must be applied at 90 deg. to the firebox plate. Where the firebox expands more than the outside shell, the forward row of bolts when row must be aligned at less than 90 deg. to take up the expansion and to pull properly when expanded and under load. In drilling, holes must be kept small enough to allow full thread, and the reamer run through the outside and inside plates simultaneously to insure true alignment. High speed steel taps are superior to carbon taps as they last longer, do not wear down on the threads as quickly, and the threads do not get progressively worse as more holes are tapped. Baldwin has found that a refrigerant base oil mixed with paraffin is most satisfactory for a lubricant in staybolt tapping; it doesn't burn out or clog, and it adheres to the tap better than ordinary cutting oils. Optical Comparators are the best way to check threads as they magnify the thread 50 times and permit checking simultaneously the outside diameter, root diameter, pitch and the fullness and shape of the thread.

Air Brake Association Holds Annual Meeting

Papers describe latest approved maintenance practices and some recent developments in braking refinements

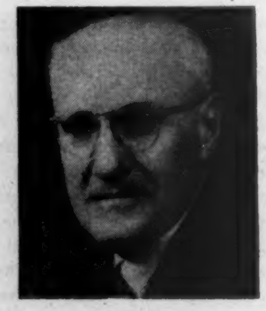


R. G. Webb, President
(Superintendent air brakes, C. M. St. P. & P.)

C. E. Miller, First Vice-Pres.
(Superintendent air brakes and steam heat, N. Y. C. System)

F. C. Wenk, Second Vice-Pres.
(Superintendent air brakes, A. C. L.)

L. A. Stanton, Third Vice-Pres.
(General air-brake instructor, Grt. Nor.)



L. Sillcox Sec.-Treas.

The forty-first annual meeting of the Air Brake Association, and the third as a member of the Coordinated Railroad Mechanical Associations, was held at the Hotel Sherman, Chicago, September 19-22. President R. G. Webb opened the meeting with a brief welcoming address. He called the attention of the members to the fact that the papers prepared for presentation were the work of some of the best informed air brake men in the country and that it was the duty of every member to gather all the information available at the annual meeting.

The opening session on Monday afternoon was devoted to maintaining air brake parts, and in it were presented papers on the shop maintenance of brake, control and feed valves. The second day the Air Brake Association listened, in joint session with the Railway Fuel and Traveling Engineers' Association, to an address by L. K. Sillcox, first-vice-president, New York Air Brake Company. At this joint session, passenger train braking and freight train handling were also discussed.

At Wednesday morning's session reports were presented on dynamic braking and the functions, operation and testing of some recent developments in air brake systems. The afternoon session on that day heard a report on practical methods for eliminating moisture in Diesel locomotive air compressor cooling systems. A description of the brake flow indicator and why it is desirable was presented at the concluding session.

Membership in the Air Brake Association continued the steady growth which has characterized it since its revival in 1947 after a 10-year lapse. The total registration was 229 members and guests.

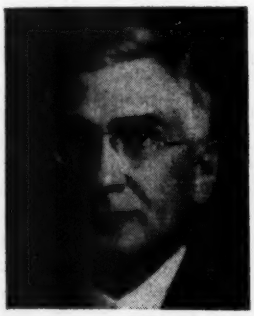
Election of Officers

The following officers and board members were elected to serve for the coming year: President, C. E. Miller, superintendent air brakes and steam heat, New York Central; vice-president, F. C. Wenk, superintendent air brakes, Atlantic Coast Line; second vice-president, C. V. Miller, general supervisor air brakes, New York, Chicago & St. Louis; third vice-president, L. A. Stanton, general air-brake instructor, Great Northern; secretary-treasurer, L. Wilcox.

Executive Committee: (for five years), K. E. Carey, general air-brake inspector, Eastern Region,

Pennsylvania; R. F. Thomas, general air-brake inspector, Canadian Pacific; D. R. Collins, superintendent air brakes, Denver & Rio Grande Western; R. J. Dewsbury, general air-brake inspector, Chesapeake District, Chesapeake & Ohio; C. C. Maynard, chief inspector of air brakes, Canadian National.

Relation of Retardation to Slid Flat Wheels*



L. K. Sillcox

By L. K. Sillcox
First vice-president, New York Air Brake Company

A vital relationship exists between train control and the service which railway systems can render, and this service is the measure of their value. Were motion not imparted to a train, it would necessitate no provision for control. To put a train into motion without adequate control would be futile and hazardous—it would be better not to move the train at all.

The trend toward lightweight in freight-car construction complicates this matter of control and renders the current standard AB single-capacity brake incapable of providing adequate braking forces throughout the range of car weight from empty to fully loaded condition. Not only is this true insofar as sufficient braking force for the single vehicle is concerned, but it is even more so when a series of cars are marshalled into a train.

Uniform Braking Ratios

An empty-car brake, or single-capacity brake, is the one most generally employed in railway service at this time. It is one in which a constant braking force is used at all times or for all conditions of car loading and one for which the braking ratio is invariably based on the empty weight of the car. If we consider just what the range in braking ratio actually is when the car varies from its empty to its fully loaded weight, we may find a car weighing 40,000 lb. empty and braked at 75 per cent of this weight with 50 lb. brake-cylinder pressure being used as a braking-ratio basis. If the car is of 50 tons variety and is loaded to its axle capacity, 169,000 lb., the constant braking force, which was 75 per cent of 40,000 lb., becomes

$$\frac{40,000}{169,000} \times 0.75 = 0.18$$

or 18 per cent of 169,000 lb. Other things being equal, the retardation set up is proportionate to the braking ratio. It is inevitable that cars braked only one-quarter as effectively as others should close up or pull away, as the case may be, according to their relative positions in the train; that is to say, it is inevitable that slack action should be intensified by such disparity of braking ratios.

The relation of slid-flat wheels to the lack of uniform retardation is not generally appreciated as fully as it might be. Action and reaction are always equal and opposite. If this is only remembered, it will be easy to visualize the effect of the rail on the train when the brakes are applied. Plainly, if the fulcrum, or point of purchase, at the contact of the wheel with the rail should fail, the wheels will slip. This failure of the fulcrum occurs when a shock breaks the adhesion between the wheel and the rail. This adhesion is generally taken as 25 per cent of the weight resting on the rail. With a good, dry condition of tread and rail surfaces, 30 or 35 per cent may be the limiting value. On the other hand, the adhesion may drop to 15 or even 10 per cent if the surfaces are slippery, due to frost, oil, etc.

If a car in motion with the brakes applied suffers impact in a direction such that the car is accelerated, the rotative speed of the wheel must be increased also, but to accelerate the wheels a certain thrust is required from the rail. This is in addition to the thrust caused by brake-shoe friction. If the sum of the two thrusts exceeds the adhesion, the wheel will slide. The impact is momentary, and the rail thrust brought into play by this impact lasts only as long as the impact. But the wheel-rail friction in this very short interval of time drops in value, becoming kinetic where it was static before, and the wheel rapidly decelerates until rotation ceases and sliding occurs. In other words, the impact has knocked the car off its feet and the brake-shoe friction which becomes static on a sliding wheel keeps it off its feet.

Even if this occurs and the wheels slide momentarily, it does not always follow that they will continue to slide. If the pull of the rail with the wheel sliding exceeds the pull of the brake shoe, the wheel will commence to rotate again and so continue. This statement should serve to dislodge the fallacy that once a wheel starts to slide it will always continue to slide, and that a wheel can be slid from a standstill with a low brake-cylinder pressure. In order to slide a wheel from a standstill or to keep a car off its feet, once it has been knocked therefrom, either the brake-cylinder pressure must be high or the rail bad or both.

An impact opposed in direction to the motion of the train can effect the same result if it is enough greater, other things being equal, to neutralize the rail thrust set up by the brake-shoe friction and carry in the opposite direction beyond the limit of wheel adhesion. The wheel once stopped in rotation, be it but for an instant, is readily locked by the brake shoe, as above pointed out, and continues to slide, provided the brake-shoe friction exceeds the wheel-rail friction. Thus, it is obvious how prolific in slid-flat wheels shocks due to lack of uniformity of braking may be.

The role of the load-compensating brake in reducing the number of slid-flat wheels and many of the evils arising from severe slack action is thus most apparent. It might be well for the Association of American Railroads to investigate thoroughly the benefits to slack control of holding the braking ratios within the range of 30 to 48 per cent instead of within the range of 18 to 75 per cent as with the single-capacity brake on cars having a gross-to-tare ratio of four to one.

The control of trains on heavy descending grades also involves the time element. The higher braking power of loaded cars offered by a load-compensating brake augments tremendously the margin of reserve and in many instances will make feasible the elimination of train delays through the use of the slow-blowdown feature of the modern release-control retainer. Where the latter advantage has been gained in the single-capacity brake only on moderate grades, it can also be had with tonnage trains on much heavier grades with the load-compensating brake.

A word of caution is justified regarding control during yard operations as well as while cars are in train movement over the road. Cases are known of switching speeds up to

* A section from Mr. Sillcox's address.

twelve miles per hour at moment of contact. Obviously such practices are untenable. We can neutralize all refinements of train operation and expensive equipment with poor yard operations, and the correction of this deficiency in practical railway operation is one that must be effected first before anything else is considered.

Shop Maintenance Practice on Air Brake Valves

Before dismantling brake valves, the exterior must be cleaned by blowing off all loose dirt and dust and, where necessary, cleaning with solvent and cloth or wire brush. The brake valve can then be placed on the work bench and dismantled. All parts should be cleaned in a solution of mineral spirits and blown dry with an air jet. Body portions and die castings with brass bushings should be immersed in hot cleaning solution long enough to clean core passages. Rinse in clear hot water, dip in hot paraffine, and immediately blow dry—being sure to blow out core passages thoroughly.

The parts are examined for wear, scratches, etc., to determine the extent of repairs required. The top cap portions should be examined for excessive wear in the rotary key opening, replacing with a new cap portion, or drill out the opening and rebush to bring it back to standard size if practical. Rotary keys should be examined for distortion and be renewed if bent. Rings on the charging valves used in L-8-PA brake valves should be examined and renewed if found worn or broken; charging valve seals should be renewed if found cracked or soft; and valve springs should be renewed if found badly rusted or short of normal free height. Exhaust, emergency and check valves operated by cams on the rotary valve key should be thoroughly examined for wear, condition of seats, or seals and springs, renewing when found necessary and seats ground in.

After all parts have been repaired or replaced they should be laid out in a clean place ready for assembling when the rotary valves and seats have been properly conditioned.

In assembling each type of brake valve, it is recommended that all new gaskets be used. Gaskets that are cracked, have flattened heads or have developed a permanent set and are thin, contribute to troublesome leakage involving possible delay in dispatching locomotives and to hard working brake valves. Thin gaskets can cause brake valves of the H-6 and K-14 type to work hard due to the close clearance between the top of the rotary valve and the top cap. After the portions are assembled, extreme care is necessary in tightening studs and cap screws evenly to insure proper seating on gaskets and to avoid binding the rotary valves. The cam-operated check valves operated by the rotary key are the last items to be applied and the lift of these valves should be measured to pass the manufacturers tolerance as shown in the code of tests. After the valve is completely assembled, it should be tested on a test rack in accordance with the test code, thus setting up a standard for repair work and assurance that the valve is ready for service.

Rotary Valves and Seats

Reconditioning rotary valves and seats has long been a subject of discussion and many different methods have been used successfully.

Where inspection shows the valve and seat to be worn or scratched, it is necessary first to reface them. This can be done with a machine in good condition to obtain a flat surface. In shops where a suitable machine is not available, the facing can be done with a special Nicholson file. Carborundum sticks kept true on a face plate are also used for this purpose. In the use of the file and Carborundum stick the operator must use care to insure a square and flat surface. Whether the valves and seats require facing is left to the judgment and experience of the mechanic.

Burrs are removed from all ports after refacing, using care not to enlarge ports while removing the burrs.

The rotary valve and seat are rough lapped separately on a lead plate loaded with a medium abrasive. The valves are placed on the plate and lapped in a straight line motion, then turned 90 deg. and lapped in a forward motion, and finally finished with a circular motion. Where lead plates are not available, the rough lapping can be done on an abrasive cloth, such as No. 80 Alundum cloth on a flat surface.

The finish lapping operation is done on a cast iron plate. A fine grinding compound, such as Carborundum W-440 extra fine, or Carborundum Silicon grain grade 2/F, is placed on the plate with a few drops of water and each piece is lapped with a circular motion. The parts are washed clean, wiped dry and burnished on the dry cast iron plate. The cast iron plate referred to is the New York Air Brake Company Piece No. N-2512 or Westinghouse Air Brake Company Piece No. 99,388.

In the above method, the best results will be obtained with a minimum of lapping. By not lapping the rotary valve and seat together, factors that increase friction are improved upon—such as the tendency to grind out the centers with abrasives creating too much bearing on the outer edges and loading the valves with abrasive.

Another method is called spotting, or scraping, and has been used successfully for many years. It requires a skilled and experienced operator. It is, therefore, slower and more expensive than the lapping method.

Where refacing of the seats and rotary valves is necessary, it is the same as discussed in the first method.

In spotting the seat, a ring having the same inside diameter as that of the rotary valve is placed over the seat and extended ½ in. above. A face plate of the same diameter as the seat is placed in the cylinder formed by the ring, and the seat is checked with bluing on the face plate. The high spots are scraped from the seat and the process repeated until a flat, true surface is obtained. Care should be taken in the use of the scraper to avoid scraping in line between the ports, but in a right-angle or crosswise direction. When the seat has been completed, the rotary valve is spotted to the seat in the same manner as the seat was spotted to the face plate.

After the seat and rotary valve have been finished, they should be rubbed together with a light oil, or if preferred, a metal polish.

Equalizing Piston Valve Portion

With the equalizing piston removed and the portion and parts thoroughly cleaned, the bushing should be checked for wear and scratches, and if necessary, a grinder should be used to true the bushing. The bushing should be washed and blown dry, then wiped with a cloth saturated with oil to fill the pores of the metal and wiped dry to remove the excess oil. The correct size ring should then be selected for the bushing, using the manufacturer's ring selection and condemning gauges. The ring is fitted to the piston and

oiled with three drops of triple valve oil evenly distributed by moving the ring around the groove. In fitting rings to the ring groove, the rings should be lapped on one side only and when placed in the ring groove the fit should be such that it will support the weight of the ring at any point in the groove circumference. When placed on the piston and oiled, the fit should be such that with a snap, or flip, of the piston, the ring will slide through the groove. Pistons with ring grooves having non-uniform width (tight spots) at one or more points should be condemned for reconditioning as pistons having defects of this nature are subject to leakage and stuck rings.

With the equalizing piston valve portions, as used with No. 8 and 24-RL brake equipments, the travel of the piston, exhaust valve and maintaining valve lift should be carefully checked and come within limits of manufacturers test code.

In lubricating rotary valves a good grade, full-bodied oil that can withstand heat and water should be used to avoid high friction. A compound known as Gargoyle Compound No. 3 has given satisfactory results. Any lubricant used should be used sparingly between the rotary valve and seat, using only enough to form a good film over the entire surface. The rotary key should be lubricated with a good grade of oil and all felt lubricators should be relubricated after cleaning by soaking in oil until thoroughly impregnated allowing them to drip excess oil before applying.

The report was prepared by L. A. Stanton, general air brake instructor, Great Northern.

Discussion

H. I. Tramblie (C., B. & Q.) said that a heavy Alemite grease seems to be the best lubricant for rotary valves because it stays there longer. It is a stringy grease and stands up for six months without trouble.

W. F. Peck (B. & O.) asked the purpose of re-paraffining. Mr. Stanton said that it reduces rust in the cores and rust incrustations, and also helps cut down grease accumulation. It is used on the Great Northern to overcome rustiness of the internal passage. It does not cause dirt and dust to accumulate in cores. It impregnates the pores of the metal.

W. E. Vergan (M. K. T.) said that it is wise to re-paraffin if a cleaning solution is used because the original paraffin that the brake companies use is lodged in the pores and the cleaning solution boils the paraffin out.

Handling of Long Freight Trains

W. B. Weightman, Chairman

The following procedures have been found practical on the Pennsylvania for handling long freight trains consisting of from 100 to 150 cars over the normal portion of the railroad.

[Preliminary considerations, such as seeing that the governor is set to maintain 140 lb. main-reservoir pressure, the standard brake-pipe pressure of 80 lb., checking the brake valves, maximum brake-pipe leakage of 5 lb. per min., piston travel on the cars between 7 and 9 in., and testing the brakes were discussed before taking up road movement of the train.—Editor.]

Starting

While starting the train, care must be exercised and the steam throttle valve must not be opened nor power applied on electric or Diesel-electric locomotives until sufficient time has elapsed to insure the full release of all brakes throughout the train. Approximately four minutes are required to release the brakes on 100 cars or more. The engineman should then apply power gradually until the slack is taken up and all cars are moving. Sand should be applied when permitted and necessary to prevent slipping drivers. If unable to start the train as outlined, take the slack of the entire train and, where conditions require, apply the automatic brake on the train, holding the locomotive brakes off with the independent brake valve, using power until the train stops, then be sure a total brake pipe reduction has been made to insure a release of the train brakes, then start carefully, stretching the slack slowly until the entire train is in motion.

While starting on a descending grade, extra care must be exercised to prevent the front end moving at a too rapid rate before the rear end is in motion. The locomotive should be moved a few feet at a time until the entire train is moving. It may be necessary to apply the locomotive brake in order to accomplish this result.

When starting a train consisting of light loads or empties on head end, and heavy loads on rear end, careful handling is required due to the slack being bunched. The head end must be kept at a slow speed until all cars have started.

Slowing Down Without Stopping

While slowing down on level territory where conditions permit, the locomotive brake, when used, must be used carefully to avoid severe train slack action and overheating driving wheel tires. While slowing down from higher speeds, first service position of the automatic brake valve is used along with a pulling throttle. Where conditions permit, after slack is adjusted, additional service reductions may be made as required according to grade, speed, and length of train. The total reduction should not be less than 15 lb. Brakes must not be released at a lower speed than is safe, that is, after all brakes are released, the speed must not be less that 10 m.p.h. After making a reduction with the brake-valve handle in first service position, release should not be made without first placing the brake-valve handle in lap position and leaving it there for a sufficient length of time to permit the brake-pipe pressure throughout the train to equalize.

Stopping the Train With the Service Brake

While operating the automatic brake valve to apply the brakes for an ordinary stop, the throttle is open or closed, as conditions permit. As the speed reduces, the throttle, if open, is closed gradually. The brake valve handle is placed in first service position, and, if speed and stop distance permit, is left in that position until about 40 ft. from the stop; otherwise, the brake-valve handle is moved to normal service position, continuing this reduction to a degree that will bring the train to a stop at the objective point. For the smoothest stop, the reduction should not exceed an amount which will reduce brake-pipe pressure to approximately 8 lb. above equalizing pressure. A final brake-pipe reduction of 6 to 8 lb is then made within 40 ft. of the stop. This reduction should be so timed that air will be discharging from the brake-pipe exhaust as the locomotive comes to a stop, as, under this condition, a greater retarding force will be built up at the head end than toward

the rear, and thus prevent any run-out of slack that might otherwise take place due to the locomotive influence. Sand should be used sparingly during the last 10 car length of the stop if rail conditions make it necessary and if it is permitted. As the braking ratio between loaded and light loaded or empty cars may be between 18 to 70 per cent, it is important that when the train consists of heavy loads on head end and light loads on rear end, extreme care must be exercised to prevent an excessive stretch out as the train comes to a stop.

When necessary to stop this kind of a train, take sufficient time, if possible, shut off the throttle and drift to a stop, using the engine brake to assist. Where it is not possible to make the stop in the above manner, the following method should be used with locomotive throttle open: place the automatic brake valve handle in first service position and leave it in this position until a reduction of 12 lb. has been made, then move the handle to lap position; endeavor to make this 12-lb. reduction far enough back so that another reduction will not be necessary to bring the train to a stop short of the objective point.

The throttle should be gradually closed after the brakes have started to apply. When the train is about 40 ft. from the stop, start a reduction which will increase the brake cylinder pressure on the head end with no appreciable brake cylinder pressure on the rear end until after the train has stopped.

Tests were made with trains consisting of cars on the head end loaded with either coal, ore or lime stone and empty cars on the rear end. A heavy application was made before the train was down to within 40 ft. from stopping which left practically no braking power in reserve to apply the brake on the head end as the train was stopping. On these tests, the head end was found to be moving at approximately 2 m.p.h. after the rear end had stopped.

When trains are made up of heavy loads on the rear end and light loads or empties on the head end, careful handling must be exercised to prevent the slack closing in too fast. The throttle should be open, if possible, and an initial brake pipe reduction of 6 lb. should be made so as to start the slack in gradually. After the initial reduction, the throttle should be gradually closed. There will be nothing gained by leaving the throttle open after the initial reduction is made, as it is not possible for the locomotive to keep slack stretched out on a train of this makeup.

Blowdown Position of Release-Control Retainer

A majority of the freight cars owned by the Pennsylvania are equipped with the release-control type of retainer. They are used to keep slack action down to a minimum while making a running release with long freight trains by placing the handle in slow direct release position (45 deg. above horizontal) on the first 25 to 35 cars, depending on the length of the train. The use of this type of retainer permits slowdowns, and the brakes can be safely released without any undue slack action or damage to equipment or lading. Without the use of this type of retainer in many cases it would require that the train be brought to a stop before releasing the train brakes.

In addition to holding the slack action down to a minimum while releasing the train brakes at locations where it is not desirable or practical to use a pulling throttle, it speeds up train movement generally.

The report was prepared by W. B. Weightman (chairman), general air-brake inspector, Eastern Region, Pennsylvania; J. P. Lantelme, general foreman, Pennsylvania System; George Ferguson, general air-brake inspector, Central Region, Pennsylvania.

Discussion

Approval of the procedure described in the report of the committee was expressed because it represents sound standard practice as advocated by the air brake companies. The importance of terminal tests and of the engineman's responsibility in helping air-brake supervisors to see that they are properly made was emphasized. A prediction was made that maximum brake-pipe leakage not to exceed 5 lb. was on the way and that brake-pipe pressures for freight trains were going higher.

Electro-Pneumatic Brake Operating Test System

C. M. Hines

The present-day system of electro-pneumatic control was first placed in actual service in 1933. Since then, the obvious advantages of the electro-pneumatic brake equipment have resulted in its almost universal adoption for passenger trains.

In addition to the time element involved, there are a number of other advantages in the electro-pneumatic brake equipment over the purely pneumatic form. The brake application begins simultaneously on all cars of a train; the pressure builds up in all brake cylinders simultaneously; the pressure releases simultaneously from all brake cylinders; the brake application is independent of the number of cars in the train; the graduation of the brake is much easier, and can be accomplished in smaller steps than with the purely pneumatic brake; the brake cylinder pressure can be maintained at a uniform value on all cars throughout the train, and leakage from the straight air pipe is automatically compensated for.

A brief review of the functioning of the electro-pneumatic brake equipment will serve to explain the connection between the electro-pneumatic brake equipment and its most recent companion, the circuit checking equipment. Fig. 1 shows in simplified form the essential elements of the electro-pneumatic brake system. When the brake valve at the left is moved to service position, pressure is built up in chamber *A* of the master controller, this pressure being proportional to the travel of the brake valve handle. This pressure causes shaft *B* to move to the right, closing two contacts which energize the application and release wires running back through the train. Each locomotive unit and car are equipped with a pair of magnet valves. When current is supplied to the release wire, all release magnets are energized, thereby closing all exhaust ports. Current in the application wire energizes all application magnets, thereby permitting air to flow from the auxiliary reservoirs to the straight air pipe. As pressure is built up in this straight air pipe, the relay valve on each car allows pressure from the supply reservoirs to flow to the brake cylinders. Meanwhile pressure from the straight air pipe has been building up in chamber *C* of the master controller. When this pressure almost equals that in chamber *A*, the shaft *B* moves to the left a sufficient amount to open the application contact. Current is thus cut off from the application wire, the appli-

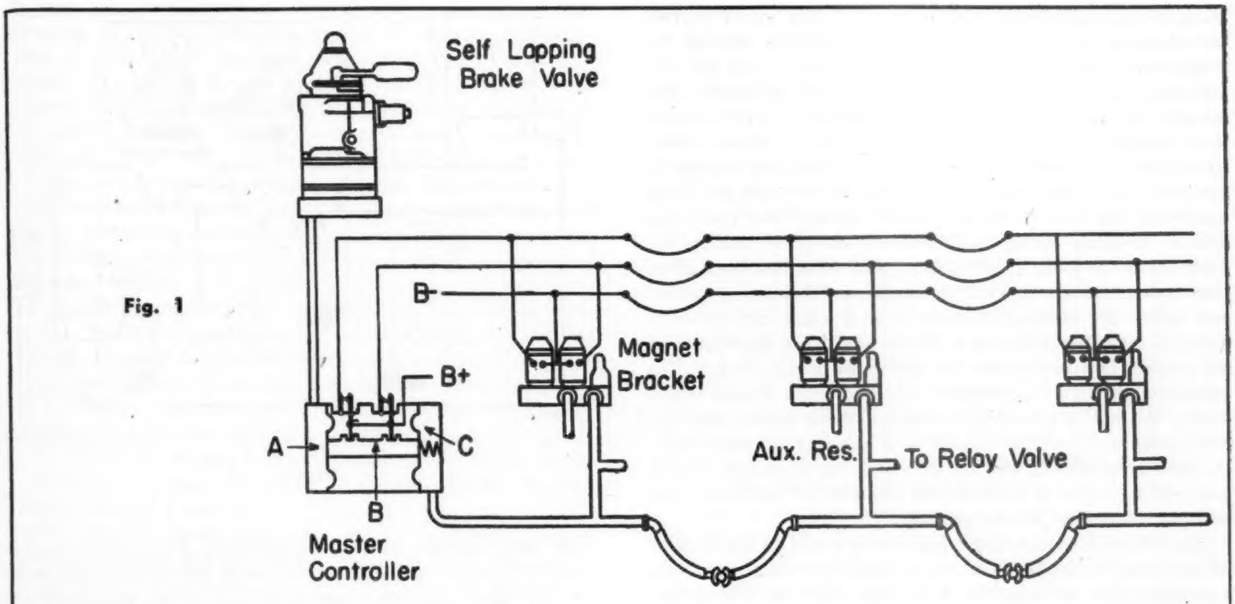


Fig. 1

cation magnet valves are de-energized, and brake cylinder pressure remains equal to that in chamber *A* of the master controller.

To release brake cylinder pressure, the brake valve is moved toward release position, which reduces the pressure in chamber *A*. Shaft *B* then moves to the left opening the release contact and allowing the release magnets to be de-energized. Straight air pipe pressure is then exhausted to atmosphere through each release magnet. The relay valves follow this movement and reduce brake cylinder pressure. It is obvious that cylinder pressure can be wholly or partially reduced as desired in small steps.

To realize fully the many advantages of the electro-pneumatic brake system, it is essential that a high degree of integrity be maintained in the brake circuits. Accordingly, it is necessary that the car connectors and receptacles be made up with adequate care and that all of the equipment involved in the brake circuits be maintained in proper condition by regular inspection. Because of the necessity for the integrity of the brake circuits, it is desirable that the engineman have available conveniently a dependable means for indicating that the brake circuits are intact. Such an indicator has been developed, and is termed the SC-2 Circuit Checking Equipment.

This circuit checking equipment gives the engineman ample warning if a faulty circuit condition develops, thus enabling him to change the brake valve shifter lever to automatic control in ample time and to be governed accordingly. If for any reason, he ignores the warning and attempts an electro-pneumatic application, or if the fault occurs just as he attempts such an application, an automatic full service brake pipe reduction will result. While the above precautions should safeguard the dependability of the electro-pneumatic system, the engineman should always remember that, even though operating in electro-pneumatic position, it is always possible to obtain an immediate pneumatic emergency by placing the automatic brake valve handle in the normal emergency position.

In considering a circuit checking system which would be suitable, the following tentative requirements were made as presenting an ideal solution:

1.—All equipment for checking should be on the locomotive in order to avoid the necessity for specially-equipped rear-end cars.

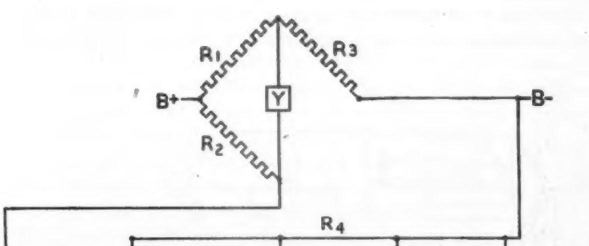


Fig. 2

2.—Because of the large number of passenger cars now in service with the electro-pneumatic brake, no change in car wiring should be required.

3.—The equipment must be designed to operate satisfactorily with trains varying in length from 1 to 24 vehicles.

4.—The equipment must operate satisfactorily over a wide range of voltage, the limits being from 58 to 80 volts.

5.—The equipment must be sufficiently rugged to operate satisfactorily on a locomotive, long life and a minimum of maintenance being essential.

6.—No power supply other than that used on present locomotives should be required.

7.—The equipment must indicate continuously in advance of a brake application the condition of the electro-pneumatic brake system.

8.—The indication means must be safe in that any failure of the equipment used for checking should provide the same indication as a failure of the electro-pneumatic brake system.

9.—The checking current flowing through the magnet valves must be sufficiently low to insure against false operation.

After long study and numerous tests with various methods, a system based on the use of the Wheatstone bridge was finally designed. As described previously, the electro-pneumatic brake system contains two (2) circuits each having a resistance depending upon the number of magnet valves connected. A Wheatstone bridge which would measure the resistance of each circuit and compare it to the value of re-

sistance required for a given number of cars would provide an adequate means for insuring that the circuits through the train were intact. A Wheatstone bridge system has the disadvantage of operating on the open circuit principle. One unique feature of the system finally adopted lies in the means for converting the Wheatstone bridge into a device which checks its own operation as well as indicating any change in the condition of the circuits the resistances of which are being measured. In case of open circuits through the train, the circuit checking system will indicate rather accurately the location of the fault. Finally, if an indication has been given that the circuits are at fault, the engineman thus being warned not to use the electro-pneumatic brake, means are provided for automatically obtaining a full service brake application if an attempt is made to use the electro-pneumatic brake. This system might well be compared to a protection system which could be used to advantage in almost every home. Suppose, for example, a leak developed in a gas line in your home. A system paralleling the circuit checking equipment would not only warn you of the leak and locate it for you, but would automatically shut off the gas supply.

Since the circuit checking equipment is based on the familiar Wheatstone bridge, it seems that a logical presentation of this equipment can be made by beginning with the Wheatstone bridge and following in several steps the evolution of the present circuit checking equipment.

A battery is connected to the left and right hand corners of the bridge and a galvanometer is connected to the upper

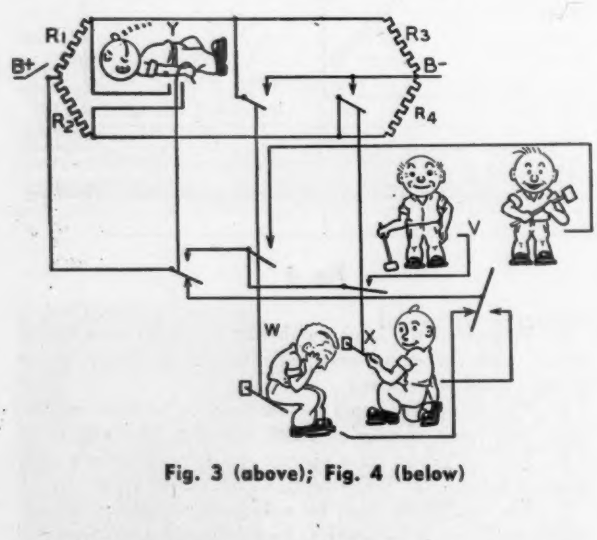
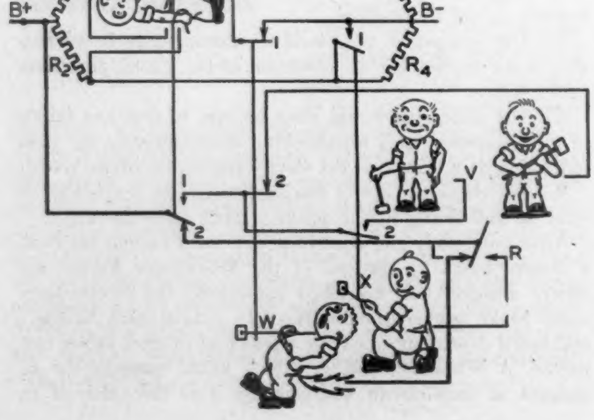


Fig. 3 (above); Fig. 4 (below)



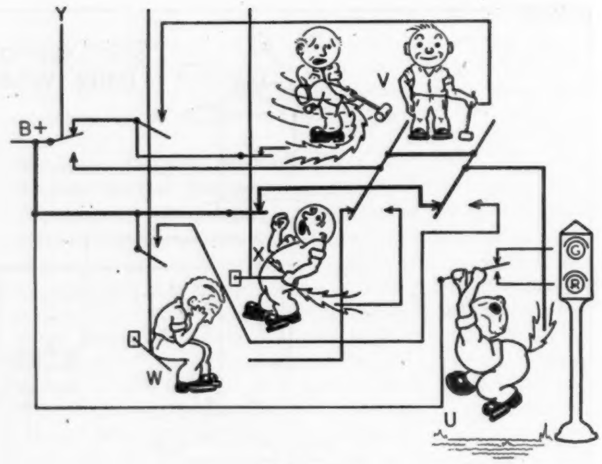


Fig. 5

and lower corners. As long as resistance *R-1* is equal to *R-2* and *R-3* is equal to *R-4*, there will be no difference in potential at the upper and lower corners of the bridge, and therefore no indication by the galvanometer needle.

Naturally an engineman could not be expected constantly to observe the galvanometer, and therefore this has been replaced by a relay. The coil of the relay is connected across the bridge in place of the galvanometer. As long as the bridge is balanced, i.e., as long as *R-1* equals *R-2* and *R-3* equals *R-4*, the relay is de-energized and a green lamp is lighted by means of a back contact. Any change in the resistance of any one of the four arms of the bridge causing sufficient unbalance to energize the relay will open the back contact and close the front contact by means of which the red lamp is lighted.

In using an instrument of this type to check the integrity of the electro-pneumatic brake circuits we can consider the magnet valves and their associated train line circuits as resistors. This is shown schematically in Fig. 2 in which resistor *R-4* has been replaced by the magnet valves. These valves are either the application or the release magnet valves.

Since resistor *R-3* must be equal to *R-4*, and since the number of cars in a train are subject to change, means must be provided for adjusting *R-3* to agree with the resistance of the magnet valves depending on the number of cars. This is done by a rheostat. In the actual equipment, this rheostat includes a calibrated dial which provides a convenient means for indicating the actual number of vehicles in a train, and also serves to locate an open circuit in the train line wires should such a tault occur.

The magnet valves the resistance of which are being measured are wound with copper wire. Since this wire has an appreciable temperature co-efficient of resistance, the magnet valves will change their resistance with temperature. Naturally, the ambient temperature will change with the seasons, since in most cases the application and release magnet valves are mounted under the cars. It becomes necessary, therefore, to compensate for this change in resistance to maintain the proper balance of the Wheatstone bridge. This is accomplished by placing a portion of resistor *R-2* outside of the locomotive where it will be exposed to a temperature approximately equal to that of the magnet valves in the train. This then becomes the temperature compensating unit used with the circuit checking equipment.

The train-line circuits consist of the application magnet valve circuit and the release magnet valve circuit. In order to check both of these, it is necessary to use two Wheatstone bridges, each with its own detector relay. If either bridge becomes unbalanced so that either relay becomes energized, the green lamp is extinguished and the red lamp is lighted.

Thus far, the Wheatstone bridge method of checking the integrity of the train line circuits has the inherent characteristic of operating on the open circuit principle. By this it is meant that for the normal balanced condition, there is no current flowing in the detector relay. The same condition of no current flow can exist because of a broken wire to the relay coil. This could be followed by a fault in the train line circuits which would never be detected. The possibility of such undetected failures is, of course, most undesirable, and it was therefore necessary that corrective measures be taken to eliminate such a condition. In other words, it was necessary that the integrity of the Wheatstone bridge itself be checked in addition to checking the integrity of the train line circuits.

Fig. 3 shows schematically in somewhat unusual form the circuits required for checking the integrity of the Wheatstone bridge. In addition to the detector relay, two time-delay relays *W* and *X*, and a polarity relay *V* are used. In this diagram, the *B* supply is open and all relays are de-energized.

In Fig. 4, the *B* switch is closed and the circuit is thereby completed for supplying current to the coil of relay *W*. This closes contacts *1* and *2*.

Leaving the illustrations, if contact *1* is closed, a short circuit is placed around resistor *R-3*. This causes the bridge to be heavily unbalanced, and therefore sufficient current will flow through the detector relay *Y* to energize it. This causes contact *1* of relay *Y* to become closed, thus completing the circuit for energizing the right hand coil of relay *V*. This polarity relay has two coils and will change the position of its contacts from right to left depending on the direction of current flow in the coils. In the action just described, the contact of this relay is moved from left to right.

The closing of contact *1* of relay *Y* also opened contact *2* and the circuit for energizing relay *W* was therefore interrupted. After the expiration of a given time delay, this relay assumes its de-energized position and its contacts *1* and *2* thus become open. Accordingly, the short circuit around resistor *R-3* is removed and relay *Y* is therefore free to become de-energized. This is true whenever there has been no decrease in *R-3* or an increase in *R-4* since the previous balanced condition which existed prior to placing the short circuit around resistor *R-3*. If resistor *R-4* has increased, there will be some unbalance remaining and relay *Y* will not drop out. It should be emphasized that the change in *R-4* need be sufficient so as not to pick up detector relay *Y*, but only to hold it energized. This is a distinct difference from the original Wheatstone bridge system described in the first part of this paper.

Assuming for the moment that resistor *R-4* has not increased, the detector relay *Y* will drop out, thus closing its contact *2*. The positions of the relays are now identical with the start of the operation with the exception that in relay *V*, the right hand contact is closed instead of the left hand contact. Due to this change, the circuits are complete for energizing relay *X* instead of relay *W*. Contacts *1* and *2* of relay *X* are closed.

This time a short circuit is placed around resistor *R-4*. Again the bridge is heavily unbalanced to a degree sufficient to again energize relay *Y* and close its contact *1*. The circuits are now complete for supplying current to the left hand coil of relay *V* and its contact accordingly moves to the left.

Since contact *2* of relay *Y* is open, the circuit for supplying current to relay *X* is interrupted. This relay becomes de-energized at the expiration of a given time delay, and its contacts *1* and *2* become open. This opens the circuit for supplying current to the left hand coil of relay *V* and also removes the short circuit around resistor *R-4*.

Again relay *Y* is free to become de-energized provided resistor *R-4* has not decreased in value since the previous balanced condition. The bridge is again balanced and all relays are in the position in which they were shown at the beginning of the operation, One cycle has been completed, and the next complete cycle is ready to begin. The relays *W* and *X* are made slow acting so as to insure proper sequence of the various operations and a complete cycle requires approximately 5 seconds. This cycling continues until such time as a change in resistance of the train-line circuits occurs. If such a change does occur, one of the detector relays will remain in its energized position after the short circuit across either *R-3* or *R-4* has been removed and the cycling sequence will therefore stop. This halting of the cycling causes the extinguishing of the green lamp and the lighting of the red lamp in the indicating panel. This is accomplished by having an additional relay *U* as shown in Fig. 5. It will be noted that the circuit for energizing relay *U* is completed whenever relay *X* is energized and relay *V* is in the right hand position, and again when relay *W* is energized and relay *V* is in the left hand position. Therefore, relay *U* receives two pulses of current during every complete cycle, and it is made a time delay device to bridge the time between pulses. If for any reason these pulses cease, relay *U* becomes de-energized and, of course, the red lamp will be lighted.

The preceding explanation described a method for checking the integrity of the electro-pneumatic brake circuits while the brakes are released. It is of course desirable to check these circuits while the brakes are applied. The method of measuring the resistance of the circuits by means of a Wheatstone bridge is applicable only when there is no current from an external source flowing through some portions of the bridge. Accordingly, the Wheatstone bridge method cannot be used when the brakes are applied since battery current flows through the application and release circuits during a brake application.

Therefore other approaches to the problem were investigated and it was finally decided to use a system which measures the amount of current flowing through the release magnets while the brakes are applied. If this current falls below the amount required for any given number of cars, it is indicative of a fault in the train-line circuits and accordingly the red light will become energized.

This is accomplished by introducing a small amount of resistance in the common return wire, and the voltage drop across this resistance is used to hold the relay in its energized position. A calibrating rheostat, which is set when the equipment is first placed in operation with the brakes released, adjusts the relay circuit so that the amount of current flowing through the relay will be proper for the number of cars in the train, provided all of the circuits are intact. If the connections to some of the cars are broken so that the current is below the normal value, the relay will release and an indication will be given by extinguishing the green light and lighting the red light.

The light indicating panel is normally placed in the locomotive cab within view of the engineman. The relay cabinet has all of the adjustments for placing the equipment in operation in the front.

When initially taking control of the train, the engineman must know the number of vehicles in the train. If the train consists of three locomotives and twelve cars, a total of fifteen vehicles would be used in setting the rheostats. The dials of the rheostat are calibrated from one to twenty-four vehicles. The engineman can then proceed to place the circuit checking equipment in operation. The On-Off switch to the left of the lights must be moved to the On position and both rheostats should be turned so that the proper number of vehicles on the dial is opposite the indicator for each rheostat. With both rheostat dials so set, the three-position toggle switch to the right of the lights is moved to the Up position. This prevents the pulsing action of the relays and at the same time inserts a milliammeter in series with the corresponding detector relay. The rheostats should then be readjusted until each milliammeter reads zero. This insures that both bridges are balanced. The three-position switch should then be pulled to the Down

position until the green light is energized, after which it may be released and it will automatically assume the center position. The calibration of the rheostat dials is merely an approximation, and the milliammeters are used to insure accurate balancing of the two bridge systems. Nevertheless, the calibration on the dials will serve to indicate to a rather close degree the number of vehicles in the train, and if there is any large variation between the dial settings and the actual number of vehicles in the train, a fault in the train wire system is indicated.

To locate such a fault let us assume that in the 15-vehicle train the rheostat dial must be set to 10 to obtain a balance for the application wire. This indicates that the fault lies between the 10th and 11th vehicles and that the fault must be in the application wire. If both rheostats registered 10 vehicles instead of 15, the fault might be in both the application and release wires, in the common return wire, or in all three. This means of fault location is applicable only if the fault is an open circuit existing in the plug connectors or jumper wires between the cars. Experience has proven that most failures in the electro-pneumatic brake system are of this nature, and consequently this method of fault location may be of considerable practical value from the standpoint of maintenance.

The report was prepared by C. M. Hines, electrical engineer, Westinghouse Air Brake Company.

Discussion

F. R. Ellis (Reading) said that on the first drawing Mr. Hines stated that *R-1* and *R-2* must be equal, and *R-3* and *R-4* must be equal. Where, instead of using the resistor and having it as in the drawing, it is used to compensate for *R-4*, and a variable resistor is used in the locomotive for *R-3*, and there is a device on *R-2* which weather conditions on the front of the locomotive would change—what compensates for this on *R-1?*

Mr. Hines replied that the ratio of *R-1* to *R-2* must be equal to the ratio of *R-3* to *R-4*. Therefore, if *R-4* changes a certain amount due to temperature, and *R-2* is changed the same amount, then the ratio of *R-1* over *R-2* equal to *R-3* over *R-4* remains the same, despite any change in actual resistance. If due to changes in cars we change *R-3* and *R-4* a corresponding amount, the equation is still balanced.

President Webb remarked that this device is foolproof. If either the circuit fails, or the device itself should fail, it will apply the brake.

L. A. Stanton (Great Northern) said that this system is worth its weight in gold. Failures cannot occur.

Shop Maintenance of Control and Feed Valves

The feed valve is the heart of the air brake system and has a most exacting duty—to supply the brake pipe with a precise pressure setting. Whenever the demand for air supply to the brake pipe varies due to leakage or other causes, the feed valve must respond at once to maintain pressure to adjustment setting to avoid undesired brake application or creep-on as it is commonly called. Yet, in maintaining pressure, the feed valve must not allow the pressure to build up above that for which it is adjusted; if this occurs, an over-charging of the system will result. Therefore, the necessity for efficient and exacting shop maintenance of these valves by skilled, competent mechanics should be realized.

The best method to develop this type of maintenance is to consolidate and limit the number of repair points designated to handle the repair work. In this way we are better able to train mechanics for this degree or type of maintenance. Also, consolidation of the work to a limited number of repair points makes it possible to establish a full time job for a mechanic or mechanics who are skilled in performing this type of work.

With feed valve maintenance confined to a limited number of points or a principal repair point, more frequent visits by the air brake supervisor and consequently closer supervision can be had. As a result, personnel at these repair points will develop a feeling of responsibility from the realization that this maintenance covers a greater portion of the railroad.

Next, the repair shop must be kept clean and equipped with the proper tools to do the type of work that is expected of it. It goes without saying that the feed valve test racks must be maintained in first class condition at all times.

F-Type Feed Valve

When dismantling feed valves, relieve the tension on the regulating spring and remove the spring box, diaphragm ring, diaphragm and diaphragm valve assembly. Next remove the four cap screws holding the piston cover, the cover, supply valve piston, piston bushing and gaskets.

Remove the choke from the piston cover.

Dismantle the piston spring, valve stem and spring abutment by compressing the piston spring until the spring retaining ring (horse shoe) is exposed sufficiently for removal. The supply valve can be removed from the valve stem by first removing the stop ring and then removing the pin holding the valve on the stem. The supply valve seat can be removed by first removing the cap nut from the lower portion of the body and then removing the seat and its rubber gasket. The diaphragm valve seat should also be removed from the body.

All brass parts should be placed in a parts pan equipped with a layer of rubber in the bottom.

All iron parts (valve body, cap nuts, supply valve seat, piston stem and cover), should be freed from all foreign substance. If necessary to remove heavily coated paint or foreign substance, boil the parts in lye water or some other suitable chemical, rinse thoroughly in hot water, remove any burrs and probe passages clear of rust accumulations or other obstructions.

Clean all brass parts thoroughly in an approved non-inflammable hydrocarbon cleaning solvent. If necessary to remove gummy substance, boil in soda water (made by dissolving 20 lb. of soda ash in 30 gal. of water), then rinse in hot water and use the cleaning solvent. Steel springs should be boiled in lye-water and rinsed in hot water.

The following gaskets must be renewed each time the valve is cleaned:

Warning port check gasket, NYAB No. EV-2203, WAB No. 86215

Warning port valve guide gasket, NYAB No. EV-2648, WAB No. 95343

Supply valve seat seal, NYAB No. EV-2188, WAB No. 86216

Valve stem guide gasket, NYAB No. EV-2188, WAB No. 86216

Other gaskets should be given close inspection and renewed if necessary.

The diaphragm ring should be free from bruises or cuts running completely across the sealing faces. The sealing faces should never exceed $\frac{5}{64}$ in. in width. The spring equalizer should be inspected for smoothness on its point. If it has an excessive coating of rust it should be renewed. The choke plug should be cleaned and the orifice checked for size. The felt filter should be renewed.

The piston bushing should be checked. The relief ports ($\frac{3}{32}$ in. and $\frac{3}{16}$ in. diameter) should be checked for size to insure full opening. Inspect the $\frac{7}{16}$ in. nominal valve guide and, if it is scored badly or is worn bell-mouthed, it should be scrapped. The inside surface of the piston bushing should be inspected for scoring. If scored slightly, it should be ground on a precision grinder (such as Heald Type No. 55). Care must be taken so that the bushing will not become distorted during grinding.

The piston stem should be checked to ascertain that it runs true with the piston and is not bent. This is important because any misalignment will result in an unsatisfactory seal of the piston ring in its bushing, thereby producing sluggish action of the valve.

The supply valve must be inspected and, if scoring or abrasions are found on the seat face, the face must be lapped flat and polished on a fine lapping plate. The valve must swivel freely on the valve stem. The supply valve stem must be carefully checked on the two guide diameters for scoring and abnormal wear. If the supply valve seat is scored or bruised on its seating surface, it must be replaced.

Diaphragms which show permanent distortion, cracks or pitting must be replaced with new ones. The regulating or pin valve must be inspected carefully and if found pitted or grooved it must be replaced with a new valve. When assembling the pin valve, it is important that the pin valve aligns centrally in the diaphragm nut.

Examine closely the face of the small stainless steel pin valve seat in the diaphragm seat cap nut. See that the seating edge is sharp. If it shows a counter-sunk edge it should be renewed. Check the free height of all springs and renew if necessary.

The warning port check valve seat should be examined and renewed if necessary. The shield should be cleaned thoroughly. When assembling the parts, use two drops of A. A. R. approved triple valve oil on the piston bushing and one drop in the piston ring roove. Distribute the oil evenly over the bushing surface and rotate the ring in its groove to distribute the oil evenly.

The stem guide in the cage bushing and the surface of the piston stem should also be lubricated with a thin coating of oil. Place a thin layer of oil between the metal diaphragms and place a drop of oil on the end of the spring equalizer. Inspect the top or sealing edge of the spring box for any irregularities. When ready to assemble the spring box, screw the spring box into the body casting and note that the threads form a relatively free fit to insure a uniform seal against the diaphragm ring. The spring box should be tightened with a hex wrench of the proper size.

M-Type Feed Valve

The feed valve should be dismantled and all brass parts placed in a parts pan as outlined for Type F feed valve parts. The iron body and parts and all brass parts should be cleaned in the same manner as described for the Type F feed valve.

The venturi passage should be inspected and any obstructions should be removed. Check to see that the venturi tube fitting and nut have not been screwed in too far so as to restrict the venturi tube passage.

The cage bushing must be inspected carefully for cuts or scoring. If it is found scored or cut, it must be ground on a precision grinder. If cuts appear too deep to exceed No. 3 ring size by grinding, the bushing must be scrapped.

The slide valve must be lapped to its seat and the slide valve and seat tested for leakage prior to a complete valve test. To perform this preliminary test, assemble the slide valve and piston in the bushing. Place the wood plug in the cylinder end and the brass test cover over the spider end of the bushing with gasket, Pc. EV-2071 (WAB 81012), sealing in the $\frac{1}{8}$ in. deep counterbore for that purpose. Clamp the fixture in a vise and admit air pressure through the $\frac{1}{4}$-in. pipe, then test with soap suds for leakage.

Check the choke for correct size and clean it free from carbon or any other foreign substance which may be present. The springs should be checked for free height and cleaned in the same manner as described for Type F feed valves.

Examine the metallic diaphragm for permanent distortion, cracks or pits. If any exist the diaphragm must be replaced.

The regulating valve and regulating valve bushing must be examined closely on the bearing surfaces. If the seat on either the valve or the bushing appears too wide, they must be replaced.

The diaphragm ring must be examined for any cuts or bruises on the sealing surfaces. If the sealing surface is worn to more than $\frac{1}{8}$ in., the diaphragm ring must be replaced with a new one. The length of the regulating valve after assembled in place must be checked to see that it is flush with the diaphragm seat. The regulating valve spring tip must be examined to see that it has a smooth point.

The following gaskets should be renewed each time the feed valve is cleaned: Cage bushing seal, NYAB No. EV-2071, WAB No. 81012; regulating valve bushing seal, NYAB No. EV-2072, WAB No. 81013.

The cover gasket should be examined and renewed if it has lost its elasticity, beads have taken a permanent set, or if it is otherwise distorted.

When assembling the feed valve parts, a thin layer of approved triple valve oil should be spread over the surface of the piston bushing. Oil should also be placed in the ring groove of the piston and distributed as described for the Type F feed valve piston. One drop of triple valve oil should be spread over the spider end of the piston, and a thin layer of oil (1 drop) should be spread on the bearing surfaces between the two metallic diaphragms. When assembling the spring box, a box wrench of the proper size should be used.

Testing Type F and M Feed Valves

The testing of the Type F and M feed valves is of utmost importance. It determines whether the re-conditioned and cleaned feed valve will meet all the requirements essential to good service operation.

The C. & O. requires a more rigid test than that specified by the standard test code. The difference lies in the ring leakage test (Test No. 4) and the range test (Test No. 8, Section A). For the ring leakage test we ask for a rate of drop from 60 lb. to 45 lb. which must not be less than 35 sec. We limit the range test to a maximum of 1 lb. and an overcharge of not more than 1 lb.

In addition to the above we have added to our test rack a second brake pipe volume reservoir 10 in. by 24 in. with a cut-out cock between the two volumes. After the standard tests are completed, we open an extra cock and charge the additional 10 in. by 24 in. reservoir, thereby doubling the brake pipe volume. We then repeat the range and overcharge tests to see if the valve performs within the 1-lb. limit. The feed valve must fluctuate evenly. This is checked by a listening post consisting of a 1-in. diameter steel sphere welded to a 16-in. long brass rod. Any binding, etc., can be detected through the listening post by placing the end of it against the valve body and holding the sphere against the car.

The additional brake pipe volume is for the purpose of giving a more rigid test and allows the test rack brake pipe volume more nearly to compare with that on later and larger types of locomotives.

After the feed valves have been cleaned, re-conditioned and tested, it is important that the pipe bracket bolting flanges be covered for shipping or storing until the valve is ready for use. We use what is called a Mystic Tape, which is a tough waterproof material. This type of tape or covering can be left on the valve until it is ready for application and then it can be easily removed and thrown away. We find this material much better than using shipping covers on this particular device.

In addition to accurate and efficient maintenance of feed valves in the shop, a decided increase in the desired performance of a feed valve from one cleaning period to another can be realized by the use of a Type F filter in the main reservoir line between the last main reservoir and brake valve ahead of the branch pipe to the distributing valve.

The report was prepared by F. C. Goble, general air brake supervisor, New York, New Haven & Hartford, and R. J. Dewsbury, general air brake inspector, Chesapeake & Ohio.

Discussion

W. E. Vergan said that the 1-lb. feed valve range on Diesel locomotives where AB train brakes are involved is sometimes too much and should be changed to something closer. When brakes creep on on freight trains, it can generally be traced back to the feed valves. "We can't tolerate any range in the feed valve," he said.

A. M. Malgren (St. L. S. F.) found trouble due to the crew playing with the whistle on the caboose tooting to their friends. Some trouble with stuck brakes and some leakage of feed valves occurred from that source.

C. D. Stewart (Westinghouse Air Brake Co.) warned against using certain devices on cabooses, such as a small generator run from the air line.

President Webb pointed out that cold weather will cause gaskets to leak which otherwise would be tight. In a test of 50 valves at 25 deg. below zero, when one leak would be repaired, another would develop. The valves were taken off cars at random for cleaning—and all were over 5 years old, with the majority 10 and 15 years old. Renewal of the gasket helped eliminate the leakage that occurs in extremely cold weather.

Elimination of Moisture from Brake Systems Of Diesel Road Locomotives*

Water in the air brake system is detrimental in many respects, principal among which are: injury to valve seats and parts due to lubricant having been washed away, formation of oxides which bind the piston rings in the groove, and inadequate air supply at times due to the volume of containers having been reduced by the water. It is, therefore, desirable and necessary to insure that a minimum amount of water enters the air brake system.

Where water is present in the air leaving the main reservoir system, indications are readily discernible in all air brake devices; a white oxide deposit is often found on many pistons, valves and other internal parts of control valves, brake valves, etc. This has a tendency to promote stuck rings, high valve friction with resultant sluggish operation and possible stuck brakes. There is, however, a marked interest being shown in the study and design of better main reservoir systems as demonstrated by many in this field today. Many tests have been, and are being conducted jointly by railroads, air brake manufacturers and locomotive builders to determine the most efficient main reservoir systems for each type of locomotive.

The location of compressors and intake filters in modern Diesel power has been fixed generally by the builders' limitations with respect to type of drive, cost, class of service, etc. In many cases, insufficient study has been given this subject to provide adequately and efficiently the most desirable system even under these limitations.

It required many years of service experience and study to eliminate excessive moisture from air brake systems on steam locomotives but present day cooling systems on this type of power have proven satisfactory. This has resulted from extensive studies over many years of compressor aftercoolers, automatic drain valves and piping locations. From these studies and present day tests, with results obtained, an efficient main reservoir system for Diesel locomotives should be available to railroads presently.

The compressor location on Diesel locomotives is usually at one end of the Diesel engine inside the engine room, either direct or mechanically driven from the engine. Main reservoirs are located in the engine room, in the nose, or under the locomotive. Some installations use three main reservoirs while others only have two. The compressor and main reservoir locations being generally fixed by the builders' space limitations leaves only piping arrangement, aftercoolers and drain valve locations to be considered in designing better main reservoir systems.

With present locomotive construction, the location of certain parts of the main reservoir system tends to increase the temperature of the air passing through the reservoirs to the brake system. This has the adverse effect of increasing the amount of water held in a gaseous form which can later precipitate in the various air brake devices.

There are locomotives in general use today having the radiating pipe between the No. 1 and No 2 main reservoirs directly in the path of heated air coming from the main generator. This condition may increase the temperature in the No. 2 main reservoir over that in the No. 1 reservoir. Other installations have insufficient circulation of air at *outside* temperature around main reservoirs and cooling or radiating pipes. This also tends either to increase or maintain excessive air temperatures in the main reservoir system.

Governor synchronization plays an important part in governor and compressor operation by allowing all compressors to load and unload simultaneously, so that no one compressor and its radiating system can be called upon to do more than its own share. This uniformity of compressor labor is not affected by excessive leakage, incorrect adjustment of governor, relative efficiency of compressor, or other causes.

From the foregoing, it seems evident that it is essential to have the entire air brake equipment so located that it will give the same satisfactory service operation as that expected from the Diesel engine. Increased study of design of Diesel locomotives from the standpoint of main reservoir systems is in order to provide a means whereby the moisture can be

* Paper of the Manhattan Air Brake Club presented before the Air Brake Association Annual Meeting, September 19-22 at Chicago.

removed more efficiently with the least increase in overall cost of the locomotive.

[At this point the paper dealt at length with the fundamental laws governing the amount of water vapor in air and its behavior as affected by temperature and pressure.—Editor.]

With an adequate main reservoir cooling system augmented by an automatic means for removing condensate, reheating of the air after it has passed through the cooling system will not be detrimental to the air brake system since it will merely serve further to dry the air. Likewise, when main reservoir air passes through a feed or reducing valve, expansion occurs which reduces the relative humidity.

The problem is to provide means for determining the amount of air that is passed into the main reservoir system and its actual water content along with the amount and where portions of this condensate collect with the present radiating systems. Then, from a study of these figures, proceed with the necessary changes within the space allotted and at as low a cost as possible, to provide an adequate main reservoir cooling system.

Modified Radiation System

One of the southeastern roads which was having considerable trouble with moisture in the brake equipment applied certain devices to A and B units of a Diesel locomotive. Standing temperature tests were made of a standard locomotive having the original main reservoir radiating system, and of one having additional radiating pipe in the system. An aftercooler with an automatic drain valve was installed in each compressor discharge pipe just ahead of the No. 1 main reservoir. The addition of governor synchronizing completed the alteration.

Previous to the standing tests a number of runs were made with passenger trains to determine the amount of compressor operation. These locomotives employed two compressors per unit each having a displacement of 30 cu. ft. per minute at 275 r.p.m. The results of the running tests indicated that the compressors on one of the units did most of the work. Percentage compressor loaded operation of the two compressors on one of these units varied between 42.6 per cent and 62.6 per cent (about 35 cu. ft. per min. per compressor) for the complete trip. Average throttle during the time that the compressor was loaded was between 4.0 and 5.1. The percentage loaded operation of the compressors on the second unit varied between 3 and 9 per cent, but most of this operation occurred while the train was stopped in stations and, therefore, the throttle was generally in idle position. The above results provided the data for arranging standing test conditions which would be somewhat comparable to running conditions.

Standing Tests in Yard

For a standing test in the yards, a 7/64-in. choke was used in the brake pipe at the end of the B Unit, which gave 61 per cent compressor loaded operation of one unit of Test No. 1. In Test No. 2, where governor synchronizing had been cut in, this same choke in the brake pipe gave 32 per cent compressor loaded operation. Test instruments used included a potentiometer and suitable thermocouples for measuring air temperatures at various points in the system. A hydrometer was used to measure the relative humidity at two different points in the air piping.

Considerable reheating took place in the second main reservoir. The temperature at the rear of the B unit was approximately 8 deg. higher than atmospheric temperature in the first test, while during the second test, the temperature at this point was only 5 deg. higher than atmospheric temperature. Some reheating took place.

During Test No. 2, governor synchronization resulted in an average decrease in compressor discharge temperatures of approximately 50 deg.

Difference in temperatures existed between the temperatures at the automatic drain valves of the first compressor of the two units. For some reason the aftercooler of the first compressor of the B unit was not as effective since temperatures were between 9 and 10 deg. higher on this unit.

It was noted that the second, or trailing aftercoolers, of both A and B units, were more effective than the leading aftercoolers. This difference apparently resulted from a small port cut in the ceiling directly over the automatic drain valves on the two trailing aftercoolers permitting some of the blower air to flow over the aftercooler.

Effect of Aftercoolers

Introduction of the aftercoolers improved the relative humidity in the brake pipe approximately 17 per cent. Humidity of the air in the brake pipe, if the temperature were taken at atmospheric, would have been better than 100 per cent on the first test and about 60 per cent on the second test, representing nearly 40 per cent improvement in brake pipe humidity of the air going to the cars of the train.

Considering the humidity in another light, the original arrangement of the cooling system of these Diesel locomotives resulted in water being deposited in the brake equipment. With the modified or improved arrangement, there would have to be an atmospheric temperature drop of between 13 deg. and 14 deg. before any moisture would be deposited. On this particular railroad this is significant for the temperature ranges encountered during the winter months vary considerably.

Following the first test, moisture was found in the No. 1 and No. 2 main reservoirs, as well as in the main reservoir piping and brake pipe between units and at the end of units. Following the second test, no water was found in the second main reservoir or brake pipe between units. However, considerable water was observed to be in the first main reservoir, where no automatic means were provided for draining.

The arrangement of aftercoolers where they could benefit from blower air provided for the Diesel engine proved satisfactory, thus emphasizing the desirability of providing sufficient air circulation around the cooling system. The closer the temperature of this air is to atmospheric, the more efficient the cooling system becomes.

Road Test Results

One of the eastern railroads began a series of road tests to determine means for minimizing the carry over of moisture into the brake system on several designs of Diesel-electric passenger locomotives. Starting with a builders' design two test runs of approximately 400 mi. each were made to provide basic data as to just what results were being experienced from a standpoint of moisture collection in the main reservoir system. A total of 3 ounces and 2.5 ounces of water was collected in the reservoirs during these two tests. The atmospheric temperatures ranged from 52 deg. F. to 72 deg. F. with relative humidities of the air being from 48 per cent to 97 per cent and containing from 40 to 79 grains of moisture per pound of air.

The main reservoir system was then altered. Two tests were run with atmospheric temperatures of from 35 deg. to 58 deg., humidity being from 39 per cent to 79 per cent with the air having from 25.5 to 32.0 grains of moisture per pound. Totals of 19.5 and 21.0 ounces of water were obtained as compared to 3 and 2.5 ounces with the original design, although the moisture content of the atmosphere

was less than half what it was during tests with the original design.

Another builder's design was likewise tested in the same territory to obtain basic data. Results of this test showed that with an average atmospheric temperature of 40.7 deg. and 43.1 per cent humidity, a total of 3.25 ounces of water was collected with the air originally containing 16.5 grains of moisture per pound, and the air temperature was reduced to 16 deg. F. above atmospheric in the cooling system.

Addition was made of two cooling units in parallel between the compressor and the No. 1 main reservoir as well as the elimination of the original cooling coil between the No. 1 and No. 2 main reservoirs. It was noted that 76.0 ounces of water was collected during a recent test run wherein the humidity averaged 73.0 per cent and the air contained 82.5 grains of moisture per pound. This improved cooling system reduced the air temperatures to within 4 deg. of atmosphere.

Other Test Results

A third railroad conducted tests on a locomotive unit similar to that just mentioned, but, in this case, the compressor was required to operate more frequently because of the greater air demand. The cooling system was the original equipment from the builder. Governor synchonizing was used. The greater the air demand, the higher were the temperatures at any given point in the system.

Conclusions

In designing a cooling system for general use, an average air demand should be considered. Experience indicates that this will be from 25-30 cu. ft. per minute. Either extreme will create its own problems which must be dealt with separately.

For the particular locomotive type in question, it was found that the cooling pattern was altered by the direction of motion. In back-up movements such as on a trailing A unit, the air flow over portions of the system were changed, markedly affecting the radiating efficiency. The result of tests on this unit indicate that the cooling system collects about 75 per cent of the water which could possibly be removed. Further tests on this unit are expected to point the way toward an improved cooling system with a minimum of expense to the railroad.

Essential Design Principles

The following principles of design are essential to satisfactory performance of Diesel-electric locomotives in meeting the exacting demands of today in maintaining on time schedules and to minimize maintenance costs:

1.—It is important that the diameter of the primary cooling pipe (compressor discharge pipe) be large enough to provide proper air flow at all times.

2.—Reduced velocity air flow is essential at critical points to the main reservoir air system to deposit maximum moisture.

3.—Relatively low velocity air flow in the main reservoir system is best obtained through multiple passages (The use of multiple passages requires special consideration to get uniform flow distribution).

4.—Automatic drain valves of reliable design can be used advantageously at certain locations in the main reservoir radiation system of some Diesel-electric road locomotives.

5.—Where automatic drain valves are not used, means should be provided for proper manual draining of main reservoirs and sumps while locomotives are at terminals and en route.

6.—Good circulation of atmospheric air should be provided around main reservoirs and radiating surfaces of the system.

7.—Careful attention should be given to the location of various parts of the main reservoir radiation system to avoid reheating of the air before precipitation of the water has been completed.

Discussion

T. T. McClure (A., T. & S. F.) said that the first group of Santa Fe freight Diesels were built with large-capacity fuel and water tanks, and radiation was not obtained underneath the locomotive. At the present time they are synchronizing the compressors, which means that the compressors, while unloaded part of the time, operate continuously, thus causing additional heating of the compressors. The intake air is taken from the inside of the engine room; the air is preheated before it reaches the compressor. Therefore, the temperature of the air at the compressor discharge is excessively high when operating due to the compressor governor or unloader loading one or two compressors of a locomotive while the other compressors were unloaded. Obviously, the compressor or compressors supplying the air under these conditions is heated to an abnormally high temperature, imparting this heat to the discharge air, further increasing the temperature of the air.

The piping arrangement on the locomotives when delivered by the manufacturers was such that it did not get the full benefit of the cooling effect of the reservoirs, because on some of the locomotives the reservoirs were connected in parallel, while on other installations, air from the compressors was piped into No. 1 reservoir slightly above the connection to the No. 2 reservoir, resulting in the air passing through these lines and not circulating through the reservoirs as it would had air from the compressors entered the reservoir below the connection for the outlet.

The application and other conditions mentioned, coupled with poor or defective air compressor piston packing rings has been responsible for considerable oil and moisture being carried back into the brake system, causing the equipment to become dirty and resulting in freeze-ups.

In endeavoring to correct this condition, Mr. McClure said that they had synchronized the operation of compressor governors to load and unload all compressors simultaneously, changed the piping arrangement at the connection to the main reservoirs, placing the reservoirs in series and connecting the pipes in a manner where the air will enter the No. 1 reservoir below the outlet to No. 2 reservoir, forcing the air to circulate up through the No. 1 reservoir before passing into the pipe leading to the No. 2 reservoir; and, in addition, extended the air compressor discharge line from the compressor through the floor into a loop involving approximately 75 ft. of 1½ in. pipe laid along the side of the fuel tank and across the end of the tank looping back and connecting into a reservoir located in front of the fuel tank. From this reservoir, the air line passes back through the floor, through a fin-type cooler into the first reservoir, thence through another cooler to a second reservoir and out through a separator, which has an automatic drain, through a filter and then to the brake system. This reservoir, located under the floor and just in front of the fuel tank, is provided with a drain valve.

Since making this installation, he said that they had been successful in eliminating the major portion of moisture reaching the brake system. Prior to this installation they experienced freeze-ups during the extremely cold weather. They had not experienced that trouble since placing the additional reservoir below the floor and said this installation will probably correct most of the trouble from oil and moisture being carried into the brake system.

C. O. Maynard (Canadian National) asked if any of the tests were made with the suction filters located on the outside of the unit. And, were any tests made with the radiation units or coils on the outside of the unit?

Mr. Hays replied that all the suction filters were located adjacent to the air compressors in the engine rooms. No suction filters were located above the roof, or outside the locomotive. That had been tried without success.

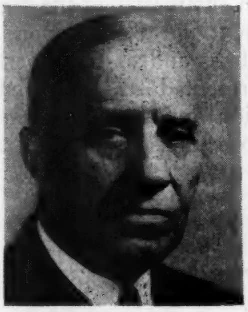
Road Supervisors Discuss Locomotive Operation

Road foremen look at their own qualifications – Discuss selection and training of firemen and training steam men for Diesels

G. B. Curtis, President
(Road foreman of engines, R.F.&P.)

W. E. Sample, Vice-Pres.
(Superintendent fuel conservation, B.&O.)

T. Duff Smith, Sec.-Treas.



PROBLEMS of train handling, management of locomotives on the road, both Diesel-electric and steam, the training of enginemen, the selection and development of road supervisors, and the selection and handling of fuel were the subjects brought before the members of the railway Fuel and Traveling Engineers' Association at its thirteenth annual meeting held at the Hotel Sherman, Chicago, September 19-22, inclusive. These subjects were presented in five addresses and 11 reports.

H. C. Wright, general superintendent motive power, Pennsylvania, Chicago, in an address at the opening session, described the methods of assignment and utilization of Diesel-electric locomotives on that railroad. At a joint session of the Railway Fuel and Traveling Engineers' and Air Brake Associations an address on Trends in Transport was delivered by L. K. Sillcox, first vice-president, New York Air Brake Company, in which he dealt with the relation of the Load Compensating Brake to the fundamentals of brake performance. On the third day W. K. Simpson, fuel and lubricant engineer, Electro-Motive Division, General Motors Corporation, talked on the Diesel locomotive fuel and lubricant aspects of petroleum. On the last day two addresses were delivered on various aspects of the relations between coal mining and the railroads. C. W. Waterman, Jr., district manager, McNally Pittsburgh Manufacturing Corporation, discussed the problems of coal sizing and preparation involved in supplying clean coal to size specifications, and J. E. Tobey, president, of Appalachian Coals, Inc., described the effect which the rapid expansion of pulverized-coal-firing equipment in stationary power plants has made in the relative position of locomotives and stationary plants with respect to the need for coal of selected quality.

At the joint meeting with the Air Brake Association two reports were presented on train handling, one on freight trains by a committee of which W. B. Weightman, general air-brake inspector, Pennsylvania, was chairman, and one on passenger trains by a committee of which F. R. Browning, supervisor locomotive operation, Baltimore & Ohio, was chairman. Five reports pertaining to various aspects of fuel combustion and smoke elimination were presented. These included the report on Front Ends, Grates and Ash Pans—Chairman S. R. Tilbury, fuel supervisor, Atchison, Topeka & Santa Fe; Economical Operation and Handling of Stokers—Chairman D. C. Black, road foreman of equipment, St. Louis-San Francisco; Smoke Prevention in the Washington, D. C., Terminal—Chairman M. G. Stewart, road foreman of engines, Washington, Terminal Company; Trends in the Cost of Locomotive Coal—Chairman A. A. Raymond, superintendent fuel and locomotive performance, New York Central System; and Fuel Economy on Oil-Burning Locomotives—Chairman T. L. Henley, chief fuel supervisor, Missouri-Kansas-Texas. Three reports on training and education of employees were presented. One, Chairman F. P. Roesch (retired), dealt with the training and duties of road foremen of engines. Reports

were presented on education of engine crews in steam service—Chairman G. E. Anderson, general fuel supervisor, Great Northern—and in Diesel service—Chairman F. Thomas, assistant to general superintendent equipment, New York Central System. One report was presented on the operation of Diesel-locomotive steam generators—Chairman R. D. Nicholson, road foreman engines, New Haven.

President Curtis Speaks

In opening the meeting the president, G. B. Curtis, road foreman of engines, Richmond, Fredericksburg & Potomac, emphasized the importance of this year's meeting in view of the radical changes which are being made in the types of motive power used on American railroads and the ever-mounting cost of fuel, supplies and labor. The changes in motive power, he said, have increased the duties and responsibilities of the members of the association, making close attention to the sessions of the meeting particularly important, both from the standpoint of what they may gain from it as well as what thev contribute to it from their own experience. In this connection he recommended careful study of the various locomotive economy devices in the exhibit of the Allied Railway Supply Association.

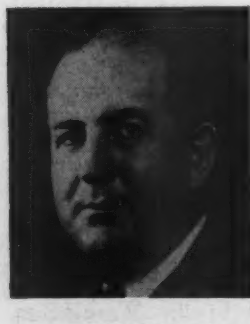
Fuel being one of the major items of expense, he said, requires that every effort be put forth to conserve it and to co-ordinate all efforts for the reduction in fuel expense to the railroads. "One of the most important duties of supervisory personnel today," he said, "is the reduction to an unobjectionable minimum of the smoke emissions from our locomotives. This, of course, goes hand in hand with good fuel economy and is the subject from which the railroads are receiving more and more complaints daily."

Election of Officers

The following are the officers who will serve during 1949-50: President, W. E. Sample, superintendent fuel conservation, Baltimore & Ohio. Vice-presidents: G. E. Anderson, general fuel supervisor, Great Northern; R. H. Francis, general road foreman equipment, St. Louis-San Francisco, and R. D. Nicholson, road foreman of engines, New York, New Haven & Hartford. Secretary-treasurer: T. Duff Smith. Members of the Executive Committee (to serve two years): P. E. Buettell, assistant superintendent fuel and water service, Chicago, Milwaukee, St. Paul & Pacific; W. H. Fortney, chief road foreman of engines, Cleveland, Cincinnati, Chicago & St. Louis; A. H. Glass, chief power and fuel supervisor, Chesapeake District, Chesapeake & Ohio, and E. L. Reeves, road foreman of engines, Baltimore & Ohio Chicago Terminal. Members whose terms will expire in 1950: J. R. Bissett, fuel supervisor, Seaboard Air Line; F. T. McClure, general supervisor air brakes, Atchison, Topeka & Santa Fe; E. G. Sanders, fuel conservation engineer, Atchison, Topeka & Santa Fe; G. Warner, fuel supervisor, Pere Marquette District, Chesapeake & Ohio. The three past presidents on the Executive Committee are L. E. Dix, retired mechanical superintendent, Texas & Pacific; S. A. Dickson, trainmaster, Gulf, Mobile & Ohio, and G. B. Curtis, road foreman of engines, Richmond, Fredericksburg & Potomac.

Following are abstracts or summaries of some of the addresses and reports, with summaries of the discussions following the presentation of the reports. Abstracts of Mr. Sillcox's address and of the report on freight-train handling presented at the joint meeting of the Fuel Association and the Air Brake Association appear in the proceedings of the latter.

The Coal Operators and the Railroads



J. E. Tobey

By J. É. Tobey*

President, Appalachian Coals, Inc.

For years the railroads have co-operated with the producers on their lines to make available to the market those sizes and types of coal then in most demand and have, themselves, purchased and utilized for locomotive fuel the sizes needing an immediate outlet. The natural result of this has been the predominant use by railroads of run-of-mine, resultant, and nut-slack coals. Whereas this practice will no doubt continue to some degree, for good and sufficient reasons its expediency is gradually decreasing and the tonnage involved should likewise decrease year by year.

This changing condition is largely a result of rapid expansion of pulverized-coal firing equipment in stationary power plants. These plants are much better adapted to the use of fine coals than are the mobile power plants with their firebox limitations and higher combustion rates.

Today's larger and more powerful steam locomotives have relatively smaller fireboxes than their earlier prototypes because of road clearance limitations, and they require drafts of hurricane velocity which naturally carry a much higher percentage of fine coal out of the stack than did the older locomotives. In fact, under heavy load conditions, some locomotives, when fired with run-of-mine or nut and slack, discharge as much as 35 per cent of the coal fired out of the stack practically unburned.

For some time the railroads have been experimenting with the use of double-screened coal on their locomotives and tests have developed the value of these sizes for locomotive steam application. It has become more and more evident that the saving to the railroads in tons used through better performance for steam generation is appreciable, so that, today, the desire of the railroads to purchase this type of coal is being demonstrated daily by their inquiries for fuel.

To meet this changing demand, the coal producer is faced

with the necessity of securing his return on a mine-run basis, as production costs and a reasonable sales margin must be attained. The coal producer will be unable to stay in business unless run-of-mine coal, which is screened into its component parts, can be sold for an overall realization at least equal to the run-of-mine value on a ton-for-ton basis. The double-screened coal, then, must bring a realization sufficiently above that of resultant to compensate for the lowered return which can be expected for the carbon sizes sold in the industrial market.

Even the first step in opening up a new coal field or a new section of an existing coal field reveals at once the indissoluble partnership—the marriage of convenience, if you prefer—between the coal and the railroad industries. From the first the new coal mine must be able to count on complete co-operation by its railroad which, in turn, will give this co-operation in the expectation of future benefits. A prodigious amount of work is required on the railroad in laying out the right-of-way, grading the roadbed, and often tunneling through the heart of a mountain to reach the site of the proposed new mine. Then, during the first few months of development, the railroad takes the coal for its own fuel, thus providing the necessary time for the producer to deevlop a market for his output.

There has been considerable improvement in coal quality since the war, and improvement is particularly noticeable in the last year. There are two main reasons for this—the retirement of marginal mines and the improvement in mechanical mining and cleaning equipment in the regular mines.

There is no question but that the railroads did a magnificent wartime job in spite of the poor quality of coal they had to use for locomotive fuel. Unquestionably, this caused a great increase in engine failures and maintenance and, naturally, left a deep impression in the minds of railroad men. Nevertheless, it is fortunate that the railroads did not have to depend on oil fuel extensively during the war, since it was in short supply and critically needed for the war effort. It can be reasonably assumed that the fuel difficulties experienced by the railroads during that period contributed materially to the purchase of Diesel-electric locomotives in the postwar years.

Double-Screened Coal

Recent tests on several railroads have shown that double-screened coal from a given mine and seam shows much better results than the same coal containing fines. The Motive Power Committee of Bituminous Coal Research, Inc., under the able chairmanship of E. C. Payne, has actively promoted further testing and evaluating of double-screened coal for locomotive use. The results of this work have been reported rather fully to this group by Mr. Payne and others at previous meetings.

[Mr. Tobey cited the results of runs on the Norfolk & Western with 2-in. by ¼-in. and 2½-in. by 1¼-in. double-screened coals in comparison with 2-in. by 0 coal, which reduced the weight of coal fired to 88.46 and 86.42 per cent, respectively, of the weight of the nut-slack coal required. Other data, he said, show that the greatest improvement is effected by the elimination of the minus ¼-in. or ⅜-in. fines, with lesser, but additional, improvement from closer sizing. A top size of 3 in. he said, minimizes crushing in the stoker, but the railroads may have to take larger top sizes to secure sufficient tonnage.—Editor.]

Inasmuch as it affects the distribution of coal very materially, the coal industry would like to have more answers to the question of double-screened coal vs. resultant, run-of-mine, or nut-slack sizes. The experience to date should be augmented by further testing on other roads in other regions. What is the value of double-screened coal on your railroad? Would improved performance justify the payment of the increased cost of double-screened coal? Is double-screened coal needed at all times in all services?

Further Improvement in Performance

There are other ways of improving the performance and availability of the steam locomotive. You are all familiar with the tests run by the New York Central, giving modern steam power the same preferential treatment accorded Diesels on the same service, and of the fine record made by the steam locomotive. Other efforts have been, and are being, made to improve the availability of steam power and excellent results have come out of some of this work, but have the results shown induced other and intensified efforts along the same line? Have new coaling and water stations been put in as needed to improve availability, or has the tendency been to make the old, and sometimes inefficient, stations do? Has any railroad equipped trucks to service steam switchers while in service, as has been done to service Diesels? Has preference been given to newer, more modern locomotive power in the back shops, or have these locomotives had to wait their turn? Has every effort been made to cut the servicing time of locomotives down to a minimum to keep the crews on their toes to get the best results out of the steam locomotive? Or, on the other hand, has the steam locomotive been losing out by default? Here is the challenge to everyone who sees the wisdom of continuing to operate our railroads on coal fuel, which is our only reliable long-range fuel.

Research

One of the most enlightening and encouraging developments stemming from the partnership of railroads and coal is the co-operative research work which is being done. I refer particularly to the program of Bituminous Coal Research, Inc., and the Locomotive Development Committee, which have been under way for several years.

It is, of course, unfortunate that this work was not started earlier, for it is very possible that the invasion of the railroad field by Diesel engines might not have occurred. Nevertheless, the coal-carrying railroads and the coal industry are spending millions of dollars for research and development projects ranging from complete new coal-burning locomotives to appliances and other means to improve the performance of existing steam power. In addition, groups of certain railroads and equipment manufacturers are engaged in locomotive development on a major scale.

* * *

Why Diesels on the Pennsylvania?

By H. C. Wright
General Superintendent Motive Power, Pennsylvania

When, some three years ago, we bought our first road Diesel-electric locomotive for test purposes, the railroad world looked aghast because no one felt that the Pennsylvania would ever enter the field. We were leaders in the development of steam power, as is typified by the T1 poppet valve, the S1 for high speed passenger, the Q1 with four cylinders (two ahead and two at the rear), the Q2, an advancement over the Q1, the S2 steam-turbine locomotive, and the J1, the war baby improvement of the C&O T1. Coal was accessible, as we operate through the prolific coal fields of Pennsylvania, Indiana, and Illinois.

However, once we had broken the ice with one locomotive and had developed the high percentage of availability as well as the fact that we could operate at high speeds on long mileage runs, we were convinced that there was economy in the Diesel. This fact, coupled with popular public demand, as well as the fact that coal costs rose from $2.00 per ton to $4.60 per ton, further convinced us.

During 1939, we could acquire the most modern high-duty coal-burning steam locomotives at the cost of approximately $150,000 each. Our electrification west from Harrisburg to Altoona, Pa., including the required electric locomotives, could be extended for approximately $47,000,000. At that time, a 6,000-hp. Diesel-electric locomotive cost about $550,000. The lower initial cost of steam locomotives or the $47,000,000 electrification project on the division between Harrisburg and Altoona, placed against the higher initial cost of Diesels would have shown only a doubtful 5 per cent or 6 per cent saving at that time.

Economies of the Program

However, during the war, and subsequent thereto, the $150,000 steam locomotive increased to $350,000, or more than double the 1939 figure, while the $47,000,000 electrification project increased to $105,000,000. In contrast to the 100 per cent boost in the price of the steam locomotive, the Diesel-electric locomotive manufacturers, by using production-line methods, were better able to regulate their costs so that the $550,000 locomotive of 1939 increased only 10 per cent, or to approximately $600,000. During the period from 1939 to 1946, wage rates increased 47½ per cent, and as of April, 1949, they had increased by 74½ per cent.

Thus, the doubtful five per cent to 6 per cent return on the Diesel in 1939, moved into a definite return in 1949 of about 30 per cent, and in some instances as high as 45 per cent. These facts, together with the necessity of a large motive-power replacement program as well as the need of increasing our operating efficiency are the most important reasons why we accelerated the Diesel program. There is also the increased public demand for smoke control, as evidenced by legislation passed by the various large cities, further restricting the use of coal as fuel.

We have moved into the Diesel program very rapidly during the past two-and-one-half years, so that we now have in service or on order 1,062,330 hp. distributed in 63 road passenger locomotives, 82 road freight or helper locomotives, and 449 yard locomotives. The cost of these will be $130,000,000.

We have only a small percentage of horsepower yet to be delivered this year. During the short time that we have been in the Diesel field, we have built up 22,000,000 Diesel-electric locomotive miles with the small percentage of locomotives we have had.

The 449 yard locomotives are performing our freight and passenger shifting, transfer work, and in many instances local freight work. In other words, we have found these very versatile in the handling of different classes of service.

The 63 locomotives, which we are using in passenger service, are hauling our east-west fleet of trains between Harrisburg, Pa., Pittsburgh, Cleveland, Ohio, Chicago, Detroit, Mich., Cincinnati, Ohio, and St. Louis, Mo. When we first acquired our passenger locomotives, we operated them as 6,000 hp. but early in 1948 we reduced them from three-unit combinations—6,000 hp.—to two-unit combinations—4,000 hp.—and thereby increased the number of locomotives in service. We were able to do this with all of our passenger power except the Baldwin permanently coupled units, which we are still operating as 6,000-hp. locomotives.

The 82 freight locomotives are assigned to various services. Some of them are operating on through east-west scheduled freight trains between Enola (near Harrisburg, Pa.), and Chicago or St. Louis; others are hauling ore from Cleveland to the steel mills; others are hauling coal from Cincinnati to Columbus, Ohio; while still others are hauling divisional freight trains between Crestline, Ohio, and Conway, Pa.; between Columbus and Canton, Ohio. Many of our four-unit locomotives are operated on side trips as two-unit combinations and upon return to the originating terminals are again coupled and operated as four-unit locomotives. We also have a fleet of 4,500-hp. locomotives geared for 50 m.p.h. operating in pusher service on the mountain slope between Conemaugh, Pa., and Gallitzin, and Altoona and Gallitzin, pushing freight trains up the steep grades. All of these locomotives are performing service formerly handled by steam power in the ratio of about one to five.

A Light Division Wholly Dieselized

We have completely Dieselized the Grand Rapids division, operating between Ft. Wayne, Ind., and Mackinaw City, Mich., in order to obtain first-hand information on the economies of completely Dieselizing an entire division. We formerly operated 38 steam locomotives on this division, and they have been replaced by 19 Diesel-electric locomotives. This conversion cost us $4,000,000 on a division that brings to us approximately $8,000,000 a year in gross revenues, while our operating ratio was 118. By Dieselization, we hope to reduce our operation ratio to 85, and thus show a profit.

When we started on our Dieselization program, our motive power consisted of 80 per cent steam, 17 per cent electric, and 3 per cent Diesel. By the end of 1949, our motive power line-up will be 50 per cent steam, 17 percent electric, and 33 per cent Diesel. We will own approximately 7 per cent of all the Diesel-electric locomotives on Class I roads in the United States.

Plans for Maintenance Facilities

The acquiring of approximately 600 Diesel locomotives has not only changed the motive power on the Pennsylvania, but it has called for a rapid conversion of the maintenance facilities. Nearly $14,000,000 has been allotted to cover the erection of modern Diesel locomotive facilities. Some of the facilities have been built new, such as our shops at Harrisburg, Pa., where the passenger units are maintained, and Enola (across the Susquehanna River from Harrisburg), where the through freight units are handled. At other points we have taken portions of existing enginehouses and modernized them for the maintenance of yard Diesel locomotives, while at Columbus, Ohio, we are taking a three-track, 600-ft. steam-locomotive erecting shop and equipping it for heavy maintenance work. At Altoona, where we formerly handled the major portion of our class repairs to steam locomotives, we have taken 25 transverse erecting-shop tracks, and turned them over for repairs to Diesel units. It is planned upon the completion of the Columbus shop project, to handle heavy

and class repairs on all Diesel locomotives assigned to points west of Pittsburgh at that point, while those locomotives assigned east of Pittsburgh will be handled at Altoona. This will definitely allocate the heavy maintenance work to two shops. We have set up, at the present time, to shop our road locomotives for heavy overhaul at 1,000,000 miles, while our yard and local locomotives will receive heavy overhaul at 500,000 miles. This does not mean that we do no intermediate work, because we definitely are adhering to the mileage attention programs as set up by the locomotive builders.

Training the Men

In turning from steam motive power to Diesel motive power so rapidly we experienced, at first, some difficulties from inexperience of our men. However, when we inaugurated the Diesel program and prior to the receipt of the first locomotives, we had schools of instruction set up for maintenance forces. These schools were handled by our own employes in the most part, some of whom had been trained at the locomotive builders' plants. Others had acquired the knowledge from other sources. When the locomotives were received, trained personnel rode with the engine crews and instructed them. Certainly we had failures of the equipment, and we had man-failures, and we are still having both of them, but they are decreasing. Our road foremen, their assistants and traveling enginemen, have done a grand job in training their men in the handling of the Diesels. Some of the men are anxious to learn all they can about the mechanics of the Diesel, while others only want to know how to operate the throttle and the brakes. However, we hope in the not too far distant future to have as well a qualified group of men operating our Diesels as we had operating our steam locomotives.

What the future holds for the Pennsylvania in the way of additional Diesel horsepower, only time will tell. If the economies of the situation will work out to our advantage I assume that we will buy additional horsepower, in fact, I don't see how we can do otherwise.

Saving Fuel on Oil-Burning Locomotives

T. L. Henley, Chairman

If good results are to be obtained, it is essential that all Departments of the Railroad co-operate in the saving of fuel.

Each employee must be sold on fuel economy. To accomplish this, Division and local officers must display genuine interest in saving fuel.

It may seem that improvements in locomotives and train operation have about reached their maximum limits and that any further fuel saving may be quite difficult to accomplish. As a matter of fact, however, there are some ways remaining whereby we can make further savings. The two most important of these are closer supervision and the education of enginemen and others in the economical use of fuel.

The first few weeks of employment are probably the most important in the career of the inexperienced employee. During this period he must receive basic instructions in proper working methods. More important, he forms habits which, to a great extent, are patterned after the methods he is taught during the initial training period. If he is taught the necessity of economizing in the use of fuel, his interest in saving fuel will grow as he gains experience.

You can't make a good fuel conservation record without good supervision. The term "supervisor" is broad and, as commonly used, includes anyone from general manager to section foreman. The mere presence of a supervisor is an incentive to employees to put forth their best efforts. Supervisors must go out on the line with the men and observe them as they perform their duties, and be able to give constructive criticism when needed. The men must be encouraged, to feel free to come to the supervisor for his aid and advice.

There are many practices which, in the past years, have proved very successful in conserving fuel. These must be kept before the enginemen constantly. One of the most important of these practices is keeping the locomotive in good mechanical and operating condition. This will have a good moral effect on the crew and will inspire them to conserve fuel. There is nothing more demoralizing to an engine crew than to operate an engine which is not functioning properly.

Fuel meetings are very important to any fuel conservation program and the men attending these meetings must be encouraged to take part in the discussion.

Oil Firing Practice

Residual fuel oil should be heated to a point where it is not too warm to cause it to lose part of its gases and yet not cold enough to prevent it from flowing freely to the burner. Oil should be delivered to the locomotive by the roundhouse forces at a temperature from which the engine crew can heat the oil sufficiently before time of departure of the train from the terminal.

It is important that the burner be adjusted so that the blaze will strike about the middle of flash wall and lined exactly in the center of firebox. In case the burner is cracked, the mouthpiece clogged up or the atomizer opening partially stopped up, it will prevent proper steaming and cause black smoke. It should be examined frequently for these defects by the roundhouse forces as there have been many cases wherein engine crews have mistaken the real reason for an engine not steaming, thinking the trouble was in the front end.

Black Smoke must at all times be avoided. The appearance of black smoke at the stack of a locomotive which is in good mechanical condition, is an indication of improper handling on the part of the crew. If an engine does not steam with a small amount of smoke issuing from the stack, it will do no good to make it smoke in excess as this will only cause the flues to be covered with soot, resulting in a waste of fuel.

Flues should always be cleaned of soot immediately after leaving terminal or after the engine has been standing for some time. They should be cleaned out as often as necessary using sand until there is no black smoke issuing from the stack. This is an indication that flues are left free of soot. Just before reaching the terminal, attention must be given the flues in order to leave them in a clean condition. This will improve the steaming and save fuel.

The atomizer should be set to use the least amount of steam to produce a white flame or complete combustion. Too much steam causes damage to the flash wall, produces drumming and may cause carbon to form on the flash walls. Too light atomization causes a red fire, black smoke and imperfect combustion. The amount of steam necessary to atomize the oil depends upon conditions and will vary according to the operation of the locomotive.

Setting of the valves is another point that cannot be overlooked and must be given consideration in order to provide proper steam distribution. This will eliminate the necessity of working the engine unduly hard.

Engine crews should familiarize themselves with the profile of the road over which they are operating the locomotives. This will result in a saving in fuel as they will then be able to take advantage of any easement in the grade line where it is unnecessary to have maximum steam pressure.

Close co-operation between the engineman and fireman always produces good results. If the engineman will signal to the fireman any changes in the throttle opening or cut-off, it will enable him to make necessary adjustments.

Proper train dispatching and make-up of the train, with reference to loads and empties, being properly placed, all tend to conserve fuel. This will also eliminate much rough handling of equipment and damage to lading.

The valves in the manifold should be checked frequently to see that they are not leaking. The burner blow-out, oil-line blow-back and jacket heater valves, if leaking, will retard the steaming of the locomotive and in many cases cause steam failures.

One of the most serious offenses in wasting fuel is around the terminals. Engines that are allowed to stand with fires burning consume great quantities of fuel unproductively. These conditions can be eliminated by close co-operation between the chief dispatcher, yardmaster and roundhouse foreman.

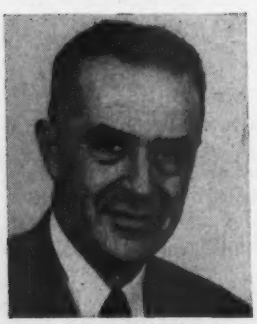
The relatively small steam space in the modern locomotive boiler should not be reduced by a high water level. This retains a great amount of moisture in the superheater units, which causes a drop in the superheater temperature. In addition lubrication in the cylinders is destroyed and damage to machinery may ensue. This also has an adverse effect on the fuel performance.

Fuel oil unloading boxes should be high enough so that water cannot drain into them and lids on the boxes must be kept closed and tightly fitted. Roofs on fuel-oil storage tanks must be frequently inspected to see that there are no leaks. Leaky heater coils in storage tanks must be repaired as soon as discovered.

All of the above mentioned conditions are detrimental to fuel conservation and must not be allowed to exist.

This report was presented by Chairman T. L. Henley, chief fuel supervisor, Missouri-Kansas-Texas.

Education of Diesel Crews



F. Thomas, Chairman

Good results have been universally obtained by the education of enginemen and firemen prior to the assignment of Diesels to their district. This instills a familiarity and confidence in the new equipment that is hard to come by in a crew that suddenly find themselves in Diesel service without benefit of previous training. Good will between management and crews is also brought about because these men are quick to realize that a good deal of calculated planning has preceded the actual assignment of diesels to the district and that their unfamiliarity with the equipment has been fully considered.

At the present, several different methods of instructing crews are in general use. These are as follows: (a) The Diesel instruction car; (b) on-the-job instruction by road supervisors; (c) actual instruction on a touring road Diesel unit; (d), classes held in engine terminals; (e) company compiled Diesel-locomotive operating manual.

The Diesel Instruction Car

The Diesel instruction cars are company owned. They vary from a car that contains a blackboard, screen, slide and motion-picture projector and folding chairs to one that includes the complete electrical equipment of a locomotive from the engineman's control stand, engine-control panel and small Diesel engine to all the parts found in the electrical cabinets as well as the governor and governor control and a complete steam-generating unit. All of the foregoing can be operated and all road conditions duplicated.

On most railroads a supervisor of diesel instruction is in charge of the instruction cars and under him on each car he generally has from one to two instructors. Where two are used one is from the operating department and one from the mechanical department. The former instructs on the actual operation of the Diesel locomotive while the latter instructs on the various parts of the locomotive and their function in the over-all operation.

The car follows a prearranged schedule of stops and classes. The classes are as informal as possible, with questions asked freely, and everyone is free to come and go as they see fit. Emphasis is placed on the actual handling of the equipment under operating conditions. Each engineman, in turn, takes his place in the engineman's seat, and, after first familiarizing himself with the handling of the throttle, the reverse lever, selector handle, brake valve and the various control buttons, goes through a normal sequence of operating just as he would do on the road. Either crew man starts the engine, puts it on the line, and, together they work their way out of problems set up by the instructor. These problems include ground relay action, engine failing to load up, stuck starting contactors, burned-out fuses or tripped circuit breakers, engine overspeed and automatic brake applications due to safety food-pedal release, locomotive overspeed and train stop applications, etc.

The same procedure is followed in the operation of the steam generator.

In addition to the actual equipment on the car, the instructors are aided by charts, slides, motion pictures, silent and sound, records and a wire recorder. These are especially helpful in demonstrating the use of new or redesigned equipment.

Where a company-compiled Diesel-locomotive manual is distributed to all the crews, the instructor's material conforms very closely to that in the book.

On-the-Job Instruction by Road Supervisors

New crews, assigned to a Diesel road engine for the first time, are accompanied by one or more road supervisors. These supervisors include the road foremen of engines and assistants, assistant supervisors of air brakes, fuel supervisors, Diesel supervisors, and Diesel inspectors. These men ride with crews for an average of about ten trips or until the road foreman feels that they are qualified.

These supervisors, in the most cases, have had whatever schooling the manufacturers have to offer. In addition, they make it a point to visit the Diesel instruction car each time

it is in their territory to keep in touch with current developments. Some of the supervisors have also had a certain amount of shop training.

While on the locomotive, they make sure that the crew understands how to start and stop the engine and how to put it on the line. The location of safety and protective devices is pointed out as is also the nature and function of the different parts of the locomotive. The engine crew is shown how to start, stop and put the steam generator on the line, and, in the case of two generators, how to balance the generators so that each is contributing its share of steam to the trainline.

During operation, the crew is instructed in the proper handling of the electrical equipment from the control stand so as not to misuse it. The new features of the brake equipment are pointed out to them, and they are shown how to recover from an automatic brake application due to a safety foot-pedal, train-stop or locomotive overspeed application, and how to recover from an emergency brake application. The engineman is shown the proper way to start and stop the locomotive and how to handle the throttle over railroad crossovers and during brake applications. He is also shown the proper way to use the dynamic brake on locomotives so equipped.

The road supervisors, where a company-compiled Diesel-locomotive operating manual is distributed to the crews, clarify the instruction in the operating manual insofar as protection of the equipment is concerned. The road supervisors from the operating department, are, of course, qualified to operate the locomotive and qualify crews.

Actual Instruction on a Touring Road-Diesel Unit

In some localities, instruction of crews has been aided by the use of an actual road Diesel unit, loaned from the operating department for this purpose. The unit is placed at each of the engine terminals in the district. Small classes of not over five or six men are conducted, briefly explaining to the enginemen some of the more important features of the operation including the engineman's control stand, the engine control panel, location of filters and screens in the fuel-oil and lubricating-oil systems, emergency fuel valve and other important items.

Road supervisors serve as instructors and in some cases they are aided by representatives from the manufacturers.

This type of instruction is very valuable but is quite limited due to the fact that road Diesels are placed in revenue service almost immediately upon delivery from the manufacturer.

Classes in Engine Terminals

Engine crews are being instructed by classes held in their own terminals. All of these classes are endorsed by the company but a great many of them are being conducted on the initiative of the individual road supervisors for which they deserve a great deal of credit.

These classes have two advantages. First, they can be scheduled for the best local convenience, and secondly, there are no strangers present and the enginemen feel more free to bring up their problems.

As a general rule, it has been found more beneficial to run these classes so that at one meeting, only one particular function of the locomotive is taken up. For example, in one meeting the fuel system is taken up, in another meeting, the lubrication system, and so on.

In the more vigorous of these programs, the road supervisors are aided by instructors on loan from the Diesel instruction car and from the manufacturers.

Charts, slides and motion pictures are in general use in these classes.

Company-Compiled Diesel-Locomotive Operating Manual

The company compiled Diesel-locomotive operating manual has been generally accepted as one of the best means of educating engine crews. It consists of a composite listing of operating instructions for each type of road locomotive owned by the company. Because of its loose-leaf make-up, it is adaptable for the easy insertion of instructions on new or re-designed equipment.

The operating manual confines itself to the essentials in regard to the operation of the locomotive. It is in no sense of the word a maintenance manual.

The following will give some idea of the subjects covered by the operating manual: Precautions before starting oil engine, starting engines and putting engines on line, preparations for moving the locomotive, starting the train, establishing dynamic braking, stopping engines, changing operating cabs, leaving the locomotive for layover, towing the locomotive dead in a train, operating precautions, electrical precautions, shut downs in freezing weather, and draining locomotive in case steam is not available. Instructions on the steam generator are also included, as is a section devoted to questions and answers for firemen and enginemen of troubles they might incur enroute and those which they could remedy.

Illustrations are freely used throughout the manual. These include schematics of the engine cooling, fuel and lube-oil systems, selector handle latching and the steam-generator flow diagrams. Also included are the following photographs: the electrical cabinets to show locations of fuses and circuit breakers, the engine overspeed-trip reset lever or button, the engine-control panel, the engineman's control stand, shutter operating mechanism, the emergency fuel cut-off valve the load and transition indicating meter and the steam generator.

The steps to be followed under each of the above subjects are listed numerically in the proper order as they would be done on the locomotive by the crew. The phraseology used is of the type that will be readily understood by all the crews.

The distribution of these manuals is handled by the road foreman of engines whose duty it is to see that they are placed in the hands of those crews who are actually in Diesel service. At the time these manuals are distributed, the crews are instructed to return any operating manuals published by the manufacturers that they may have in their possession. In this way, all the crews, no matter in which territory they operate, are governed by one set of instructions.

The company manual is also used to lontrol any contrary off-hand operating instruction that would otherwise be given out by representatives from the manufacturers. As a rule, when these representatives find that the railroad has its own set of written instructions, they will adjust theirs to conform, thereby eliminating a great deal of confusion that would otherwise be present among the operating men who would be instructed one way by their company and another way by the manufacturer.

The chairman of the committee which prepared this report is F. Thomas, assistant to general superintendent equipment—Diesel and electric.

Discussion

The need for patience during the period of training steam-locomotive crews in the operation of Diesel locomotives was reiterated during this discussion. To overcome road failures it is important to teach the men trouble shooting just as soon as possible. The problem of keeping operating manuals within practicable limits on roads which have locomotives from all the builders in service has led the New York Central to develop a single manual 4 in. by 3 in. which is only one-half inch thick in which is everything which is considered necessary for the engine crews to know.

Education of Engine Crews—Steam

This report of a committee, of which G. E. Anderson, general fuel supervisor, Great Northern, was chairman, reviewed the change in qualifications for firemen which were brought about by the advent of the mechanical stoker. Whereas, formerly husky young men were sought for as enginehouse laborers to become firemen, young men are sought who have a high-school education and are characterized by keenness of observation, strong personality, and a willingness to carry out instructions. Normal age limits are 18 to 25 years.

Instructions include rules covering proper combustion, general operating rules, and rules applying specifically to the territory. The young man is expected to utilize his spare time in preparing himself for the progressive mechanical examinations. Newly promoted enginemen need the guidance of road foremen on the first trip as enginemen in order that they may develop self confidence. The importance of a promotion incentive beyond seniority was stressed.

Discussion

Throughout the discussion of this report the importance of getting the new men started off right was stressed. This is best accomplished by having the road foreman or his assistant accompany the student fireman on his first trip. Or, if this is impracticable, he should be placed in the hands of a crew who will take some interest in getting him started right. Many members commented on the complete lack of responsibility which many enginemen take in helping new men. On roads which receive coal from many sources which vary in quality it was suggested that the new fireman should be taught to distinguish between them and learn how to handle them as early as possible during his training. Confining student trips to local freights rather than time freights or passenger service was advocated because the fireman will be more willing to let the student handle the fire.

Trends in Fuel Cost and Use

A. A. Raymond, Chairman

Coal used in 1949 is going to cost overall about the same number of million dollars as railroad fuel cost in 1943, but we are going to use only half as much coal. Perhaps it's twice as important to save a ton now as it was in 1943. So far as Diesel oil is concerned, a steady increase in cost per gallon is shown until the 1949 reduction. In 1939 38 million gallons were used and in 1949 it is estimated that there will be thirty-eight times as much. Meanwhile, from 1939 to 1949 the price per gallon has approximately doubled.

It is interesting to note that since 1939 the price of coal has increased 117 per cent and the price of Diesel oil has increased 104 per cent.

Figure 1 shows the gross ton-miles handled by coal-burning locomotives in per cent of the total, starting with the year 1936 through 1948, and an attempt has been made to estimate the trend in future years. In general, it might be said that about 80 per cent of the railroad business was handled by steam locomotives in 1936 and that in 1958 it looks as if not more than 20 per cent, possibly substantially less, would be handled by steam locomotives. This indicates the constant study that must be made to store surplus steam locomotives as Diesels are received.

From 1942 to 1948 the coal used per passenger car-mile increased 19.4 per cent; per thousand gross ton-miles, 9.7 per cent, and per switching locomotive-mile, 12.4 per cent. During this period the price of fuel has about doubled, so that instead of about a 10 per cent loss, it is a 20 per cent loss. It would seem that this requires particular attention, because it has been found that as Diesel locomotives are placed in service, the coal-burning locomotives are not stored in the proper ratio. One railroad which the reports indicate has been very active in eliminating coal burners in proportion to Diesels received shows a very good fuel performance, while another quite similar railroad, where apparently it had not been practical to store the coal burners, shows a very adverse fuel performance. That is, the storing of coal burners commensurate with the receipt of Diesels is a means of at least showing up this adverse trend in the amount of coal required to do a unit of work.

Effective Coal Size for Road Locomotives

Figure 3 has been presented before this Association and the National Coal Association by E. C. Payne of the Pittsburgh Consolidation Coal Company. Assuming that a road locomotive uses 13,000 tons of coal a year, the difference, simply based on stack loss, between using run-of-mine and egg, allowing 25 cents extra a ton for the egg coal, shows a saving for one locomotive of $4,500 a year. This is based only on the stack loss and doesn't include the many other items that would make an additional saving in coal. In addition to fuel saving, the necessity of reducing the emis-

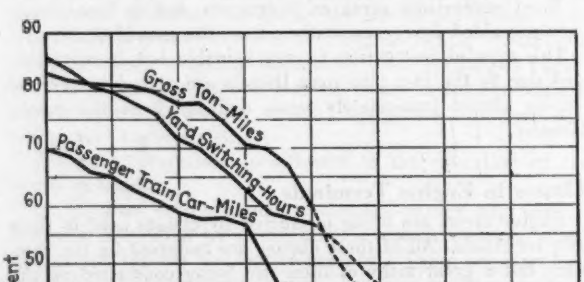


Fig. 1—Per cent of actual and prospective total railroad business handled by coal-burning locomotives, Class I railroads

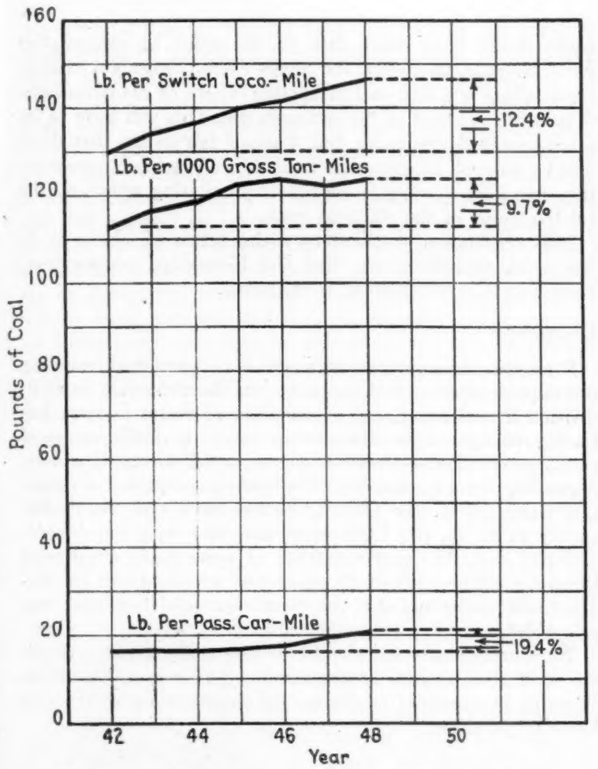


Fig. 2—Unit coal consumption—Class I railways

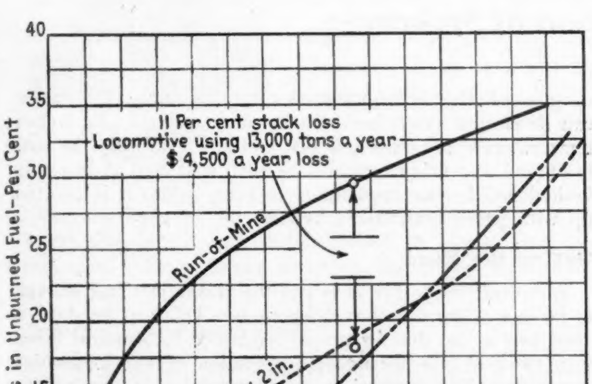


Fig. 3—Unburned fuel loss on coal-burning locomotives

sion of solid material from locomotive stacks—that is, the reduction of so-called fly ash—becomes of even greater importance than the saving in cost of fuel, because of the public pressure that is being put on all industry to stop throwing dirt of any kind into the air.

Figure 4 represents a main-line division of a large railroad having a total freight business of 8½ billion gross ton-miles a year, handled by coal-burning locomotives which accumulated approximately four million miles. It will be noticed that there had been a steady increase in the pounds of coal per thousand gross ton-miles for two years up to that date. Since the egg coal was put in service, the general trend is a 15 per cent reduction in fuel required per unit of work.

QUANTITY AND COST OF RAILWAY FUEL OIL

Year	Total tons or gallons	Total cost	Average cost per ton or gal.	Effect of Price increase over 1939
		COAL		
1939	73,935,025	$175,226,000	$2.37	
1940	79,627,318	186,328,000	2.34	
1941	91,655,061	225,471,000	2.46	8,248,955
1942	109,618,324	282,815,000	2.58	33,981,679
1943	122,593,389	357,973,000	2.92	67,426,364
1944	122,653,989	387,587,000	3.16	96,896,652
1945	115,153,596	378,855,000	3.29	105,941,303
1946	100,485,542	383,855,000	3.82	145,704,033
1947	100,437,382	414,497,000	4.13	176,769,789
1948	87,836,598	451,313,000	5.14	243,307,376
1949 Est.*	65,877,448	338,610,000	5.14	182,480,530
		DIESEL OIL		
1939	38,566,080	$ 1,694,979	$.04395	
1940	58,103,699	2,603,046	.04480	49,388
1941	97,200,254	4,389,563	.04516	117,612
1942	152,597,194	7,704,632	.05049	997,985
1943	190,623,249	10,045,845	.05270	1,687,016
1944	282,627,538	15,129,052	.05353	2,707,572
1945	410,230,460	21,385,314	.05213	3,355,685
1946	510,695,924	28,195,522	.05521	5,750,436
1947	722,178,929	53,694,003	.07435	21,954,239
1948	1,093,245,745	115,295,870	.1051	66,742,650
1949 Est.*	1,454,016,595	130,861,494	.09	66,957,437

* Based on five months' reports.

This represents a gross saving during the period of over $100,000 in fuel after deducting the 25 cents extra per ton that is being paid for egg as compared to run-of-mine coal. This $100,000 is quoted as representative, although the actual saving was many times this, but having better weather and other favorable conditions, the saving has been discounted to a figure that can easily be defended. In addi-

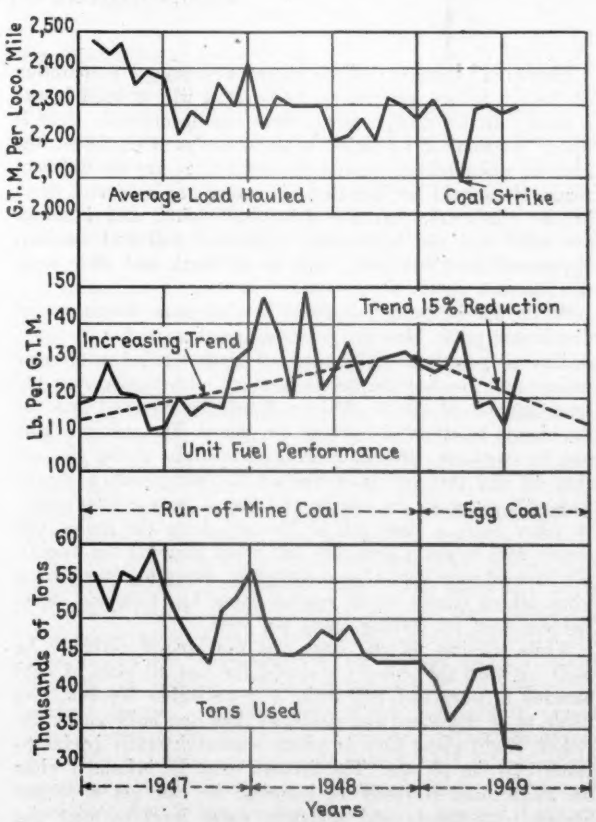


Fig. 4—Relation of coal size to the trend of fuel consumption on a main-line division of a large railroad (with 30 per cent side-line business using mine-run coal)

tion to this dollar saving, 720 fewer engines reported as steaming hard arrived in the enginehouses and 133 fewer engines were taken off trains or classed as engine failures, this meaning an additional very substantial saving.

It will be recalled that last year, as the result of 16 supervised tests runs, the Seaboard Air Line reported a 33 per cent saving. Further savings have been reported by the Louisville & Nashville as set forth in the September 10, 1949, issue of the *Railway Age*, as follows:

"Over and above the 12 per cent saving in fuel effected by the M-1's over the 2-8-2's when equivalent grades of fuel were burned, an additional saving of over 10 per cent in the coal bill has been made by using sized coal. This has resulted in a saving of over $1,000,000 a year on the railroad's fuel bill alone. The use of this sized and washed coal with all fines removed has also eliminated the stopping up of flues and the slagging of the flue sheets, and has reduced clinkering of the fire. By actual test the better coal was also shown to be capable of increasing the boiler evaporation by about 15 per cent. All coal used by the L. & N. now has a minimum size limit of ⅝ in. Most of it has a maximum size limit of 3 in. to prevent undue flaking and crushing. Coal from some areas is allowed to go as large as 4 in., and in some cases even to 6 in., depending on the combination of various qualities and the availability."

It will be recalled that last year E. S. Bonnett, fuel purchasing agent, New York Central System, recommended closer contact between fuel conservation men of the railroads and their purchasing agents so that the purchasing agent would have exact data on the value of comparative fuels, because, obviously, the mines cannot overnight change from selling one size coal to another where so many millions of tons are involved as the railroads use. This will have to be a long-range development, but it seems fair to say that there will be no such development until the railroad fuel conservation men have thoroughly sold their purchasing agents on the relative value of the different coals.

This report was prepared by a committee of which A. A. Raymond, superintendent, fuel and locomotive performance, New York Central System, is chairman.

Discussion

Evidence from several railroads was presented showing the improvement in fuel consumption, the reduction in mid-division fire cleaning, and elimination of steam failures following changes from run-of-mine coal to double-screened coal. Sizes of double-screened coal reported on varied widely, depending upon availability. The Seaboard reported a reduction from 134 lb. per 1,000 gross ton-miles with the former supply to 87 lb. per 1,000 gross ton-miles with the double-screened coal. The representatives of some roads questioned the price differential of 25 cents per ton mentiond by Mr. Raymond, indicating that the double-screened coal cost considerably more than this differential.

The purchasing agent should be given something to work on, such as the results of comparative dynamometer car tests, when he is requested to change the specifications of the coal he is to purchase.

Economical Operation of Stokers

Thorough inspection of the engine and proper preparation of the fire before leaving the ready track will at least insure a good start on a trip with a stoker-fire locomotive. Here is where economical operation begins. Assigned duties of the fireman when taking charge of locomotive vary on different roads. He should be sure that his stoker has proper oil level in the crankcase, that the drive-shaft joints and bearings are oiled and the hydrostatic lubricator full and feeding. He should have his tools, such as jet hook and slide hook if slides are used.

While fire is being inspected he can note conditions of distributor plate, blow out jets and set them to his taste.

Fire preparation will depend on local conditions to some extent and whether the fire is received with banks. Any big accumulation of ash or clinkers should be removed and the fire should be trimmed up with the shovel. The stoker engine can be tried out without making any smoke if the jets are shut off and the coal is shoved off the plate with a shovel. This will warm up the engine and free it from condensation. In many cases a good job of blowing down the boiler will enable him to get a good fire and avoid popping the engine. We have all seen a lot of coal wasted by doing too much firing when taking charge of the engine. Many bad fires and steam failures start by getting ready too soon.

While waiting for the start, the fire should carefully be built up with the shovel. A shovel fire has all sizes of coal burning at once and will make a more stable fire bed, less liable to be disturbed and damaged than one built up by the stoker. Right about here is where teamwork really begins to come into the picture. The fireman must be informed when the engineman is ready to leave so he can get a proper firebox temperature and sufficient water level to start the train without losing steam or having to crowd the fire. Thin spots or dead areas will let a lot of cold air up through them as soon as the work begins. All train-handling rules require slow speed at start. This slow speed should be accomplished with as light a work rate as possible. The stoker can be started slowly and distribution regulated. As firebox temperature determines how fast and how efficiently the coal is burned, the firing rate will be such that coal is instantly ignited and has an opportunity to burn before it is covered up with green coal. Avoid overfiring.

Out on the Road

The ideal way to fire is to run the stoker just fast enough to keep a uniform firebox temperature. This can be done a good part of the time by proper teamwork. Economical firing is a two-man job. Economical operation of the locomotive comes first. The fireman's constant attention is required to avoid any condition that will tempt him to crowd his fire. His experience and knowledge of the division enables him to plan ahead for heavy or light work rates. As a rule, the injector or water pump is worked about like and in harmony with the stoker. He can gain a little water when he knows he is going to need it. At the same time he can thicken his fire bed up for an approaching hill. It is very necessary to keep a good bright fire that will respond to a quick change when firing in rolling or hilly country. Here the work rate goes from one extreme to the other in a very short time. If the stoker is properly used downhill, it will not be necessary to over-fire when starting up. When the top of the grade is reached, let the fire burn out clear occasionally and any irregular condition can be corrected before it affects steam pressure. The firebed can be kept at proper level by light shaking, done when the engine is not working hard. Clinkers can usually be handled easily if they are caught in time. With some coal it is best to run the stoker slowly while shaking grates on the road.

Sidings and stops should be approached with the fire burned down enough to avoid loss at pops, the water level should be low enough to enable the firemen to add some while preparing to leave, if necessary. Stoker fires burn out

quickly and are too hot for long waits, they are prone to cause clinkers. So the fire is best maintained with the shovel, much as in leaving the terminal.

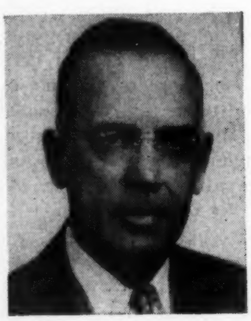
In spite of careful fuel handling from the mine to the coal chute, we occasionally get some iron, wood, rock, etc. As a rule these stoker-stoppers are quickly disposed of by a few reversals, but when the stoker stops we never know for sure it will be overcome easily. The fireman must tell the engineman at once. Many bad delays could be avoided by good teamwork at this time. If the stoker can't be started soon, it is sometimes best to stop. Keep the fire up by hand until the difficulty is corrected. If necessary to fire by hand, the jets and distributing plate are a big help on large power. Be sure to shut off steam and put the reverse valve in neutral when working around the auger.

Years ago we had very few gauges for stoker regulation; now the jet pressures and engine pressures can be read at a glance. This gives the fireman a complete picture of jet and engine conditions and enables him to avoid a lot of trial and error adjustment. As the density of the smoke tells us a lot about our firebox condition, a good clean smokestack pilot light makes night firing easier and more efficient. Some roads are having satisfactory service with all stoker tank slides removed. There is very little extra drag on the engine and the fireman does not have to go back in the tank. When necessary to dig down coal and safety rules permit, the coal gates should be opened and digging started from the gate on back so as to have the deck to stand on.

Coal should never bank up on the distributor plate, especially when tying up. Under these conditions, the corners will burn off rapidly, making it hard to get coal on the extreme back corners of grate. Leave the jets cracked when tying up and enough water and fire to keep the engine alive until the cinder-pit crew takes charge. Report any defect in the stoker, such as burned plate. Sometimes distribution trouble is caused by a clogged or open grate.

The members of this committee are D. C. Black (chairman), road foreman of equipment, St. Louis-San Francisco; E. E. Bergman, road foreman of engines, Wabash; C. M. Doane, road foreman of equipment, St. Louis-San Francisco; E. H. Ellis, road foreman of equipment, St. Louis-San Francisco.

Locomotive Front Ends and Arches



S. R. Tilbury, Chairman

The trend toward Dieselization of power on most railroads has gained such momentum as to stop further consideration of experimentation and improvements of any part of the steam locomotive. There are, nevertheless, modern steam locomotives which have many years of usefulness and many of these will still be operating when present Diesel locomotives will have to be replaced. Efficient operation of the locomotive is not only accomplished by design and construction, but also in the necessary and proper maintenance of its parts.

Relative Fuel Price Trends

The policy of operation on any railroad is generally shaped by economic conditions. During the year 1948 the cost of all fuels reached a peak and the cost of fuel in relation to work performed placed Diesel fuel as the lowest on the list, coal as a second in cost, and steam fuel oil as the highest in cost.

During the early part of 1949 reductions in fuel costs began to take place, the greatest being that of steam fuel-oil prices, which have been shown on market lists as low as 90 cents per barrel. In good locomotive performance, three barrels of fuel oil are equivalent to one ton of coal and the use of oil-burning locomotives on some roads is considerably more economical than the use of coal-burning locomotives. The reduction in coal prices has not been great so far. Reductions also took place in the cost of Diesel fuel, but not in proportion to the reduction in cost of steam fuel. Therefore, the cost of fuel for oil-burning steam locomotives is much less than that of the coal-burning locomotives and about equal to the Diesel locomotives.

Where steam fuel oil is available, it is economical for some roads to convert their coal-burning locomotives to oil-burning, or, in some instances, to extend the operation of oil-burning locomotives over what has previously been a coal-burning territory. A study of this situation would indicate that there may be some reduction in the prices of coal, that the present low price of steam fuel oil will continue, and that the greater demand for Diesel oil will tend to raise rather than further lower this type of fuel. Because of this economic situation, some roads are now converting, or giving consideration to the conversion of, coal-burning locomotives to oil-burning locomotives.

An Oil-Burning Front End

A photographic sketch of an oil-burner front end is illustrated. It has given several years of satisfactory service on the larger and most modern type of freight and passenger locomotives burning oil on the Atchison, Topeka & Santa Fe. This type of front end is simple in construction and follows in principle the best developments made in coal-burning locomotive front ends, but with no netting or table plates, except in some sections of the country where the law requires netting because of fire hazards in forest regions. The inside stack extends well down below the exhaust nozzle with the skirt at the bottom following the curve of the smokebox within about 10 in. This front end is efficient in the production of draft and produces a free-steaming locomotive at low back pressure. The low skirt arrangement tends to produce a high velocity of the gases around the bottom of the smokebox and to keep the smokebox clean of flue sand. The front portion of the skirt of the extension stack is removable for the purpose of facilitating inspection of the exhaust nozzle tip, also for making pressure tests.

Shown with this front-end arrangement, in outline only, is what is termed a telescopic stack. The purpose is to increase the height of the stack so as to prevent trailing of smoke and exhaust steam around the cab, which limits visibility when the locomotive is not being worked to full capacity or drifting. This has proved to be a very important feature on large locomotives with short outside stacks, particularly in damp or heavy weather conditions. Not only has this arrangement proved itself to be entirely satisfactory and effective in overcoming this objectionable condition, but it has tended to create a greater draft and improve the steaming qualities of the locomotives on which used. It has been possible to increase the size of the exhaust nozzle as much as ¼ in. in diameter.

This telescopic extension is made to raise and lower ver-

tically within the inside extension by means of a system of levers and an air cylinder mounted at the base of the stack on the outside of the smokebox. An air valve located in the cab accessible to the engineman controls the raising and lowering of the extension and, when raised to full height, the top of the stack is 19 ft. above the rail, 3 ft. higher than the original stack. There are, of course, some overhead structures which the stack, when extended, will not clear. Where such structures exist, warning signs placed alongside of the track inform the engineman when the stack should be lowered. Because of improved visibility and elimination of the objectionable features of trailing smoke and exhaust steam, with improvement in steaming qualities, the arrangement is in great favor with all enginemen.

A review of past experimental work and tests as set forth by the reports of the committee on this subject, indicates that present-day designs and practices have followed in principle the conclusions reached from information gathered by this committee and confirmed by actual laboratory and road tests. Twenty years ago the committee reported that conclusions reached concerning locomotive front-end design as developed by tests on the Missouri Pacific were:

1—That there are great possibilities of improving steam production and decreasing back pressure by means of larger nozzle tips, provided other parts of the front-end design are well worked out.

2—That an increase in stack diameter would often result in improved performance.

3—That for engines of the size and capacity of those now in common use, the old style lift pipe is unsatisfactory and that the inside stack extension is more effective than the lift pipe.

4—That, in order to secure the benefits available from large nozzles, care must be taken to remove restrictions elsewhere in exhaust passages.

5—That the Goodfellow nozzle seems superior to the plain exhaust nozzle tip and that the six-pronged Goodfellow tip is not generally as good as the four-pronged tip.

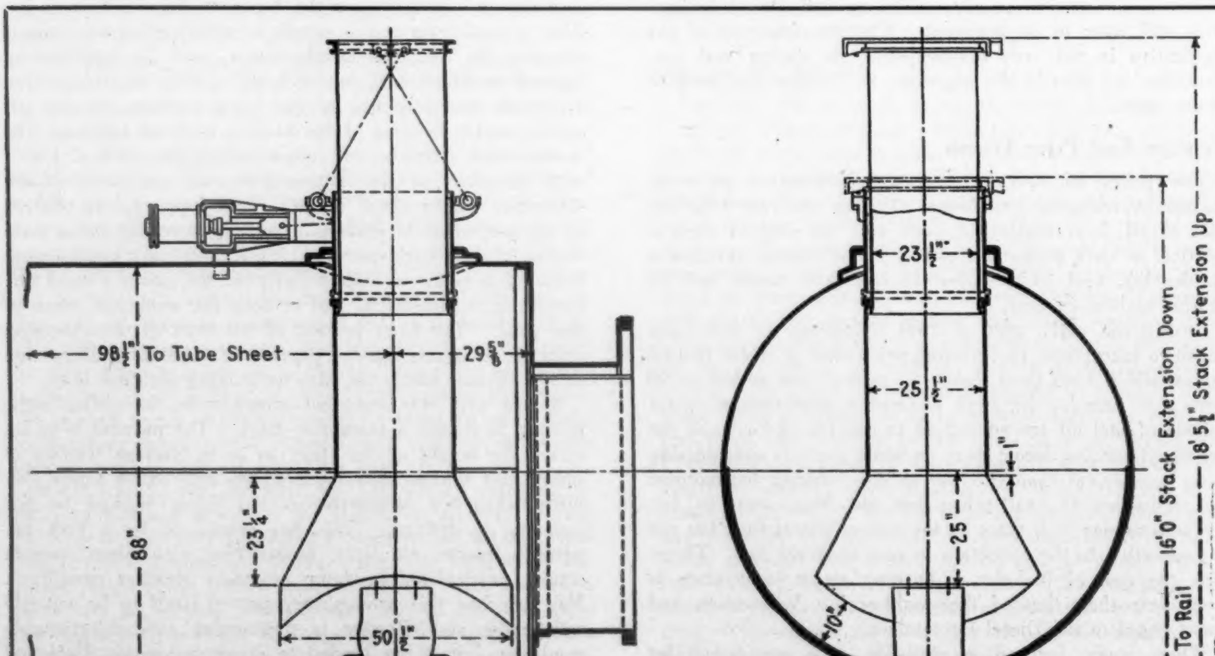
Generally speaking, present-day designs on our large and modern type steam locomotives conform to these conclusions and are giving good results in efficient service.

In 1933, the University of Illinois issued a bulletin based on a series of laboratory tests of locomotive front ends. In this bulletin is found information indicating that the four-ported exhaust tip was of the most efficient type for producing draft in relation to the exhaust back pressure. An exhaust nozzle with tip of this type has been used exclusively on the Santa Fe for more than 20 years, giving efficient and satisfactory results in producing drafts for good steaming qualities and increased horsepower of the locomotives on which it is used. It should be further stated that in the Illinois University tests, the difference in efficiency of all exhaust nozzles tested did not vary more than 12 per cent.

Efficient Spark Elimination

One of the problems of most coal-burning roads, particularly so in sections where there is a heavy growth of vegetation, is the elimination of fire hazard from sparks discharged from stacks. Generally, some form of netting arrangement is used for this purpose, but this never has been completely and satisfactorily accomplished. If the netting used is too small in its openings, draft is restricted, and, if openings are too large, sparks pass through freely without being extinguished. The use of netting often results in complete stoppage and failure because of lack of draft and no steam. This has, to some extent, been overcome by the use of the slotted type or Draftac netting with slotted holes placed horizontally so that the sparks are crushed, but pass through after being extinguished without stopping up holes in the netting. This type of netting has been reported as being very successful on the Great Northern.

The Cyclone front end is an arrangement without netting, but baffles are used and so placed that a centrifugal action is given to the cinders and sparks in which the violent twirling action tends to crush the sparks and extinguish them before passing out the stack.



A front end for oil-burning locomotives in service on the A.T.&S.F.

This type of front end has been used for many years on the Northern Pacific, with claims that the size of the exhaust tip was increased in area 12 to 15 per cent, with a reduction in back pressure of 25 per cent or more, resulting in an improved efficiency of the locomotive in fuel performance and increased horsepower. Since no netting is used, this eliminates failures due to stoppage of the netting. Complete elimination of sparks has been claimed. These claims were confirmed and reported in a bulletin of the University of Illinois as a result of laboratory tests with this type of front end.

Tight Brick Arches

The application of the brick arch has been accepted as essential to more efficient combustion on all coal-burning locomotives over a long period of years. The brick arch may be supported by the conventional arch tubes at one end in the throat sheet and in the back end at the back boiler head sheets, or supported by thermic syphons, or the more recent circulator tubes. From information gathered for, and discussions in this association, it would appear that the brick arch set tight against the throat sheet gives better results than a brick arch held open at the front end from 3 in. to 5 in. by spacer bricks. There have been claims that, with the brick arch set against the sheet so there is no opening for cinders to pass through, there will be less flue stoppage and less honeycomb accumulation on the flue sheet than with the brick arch with openings at the front end. Tests have shown on some large roads that these claims are not well established. However, some large roads have experienced less flue stoppage and flue-sheet honeycomb accumulation where brick arches are supported on circulator tubes. An explanation for this is that the circulator tubes, themselves, with the brick arch, present a baffling effect which tends to stop or reduce the velocity of the cinders and slag that would lodge in the flues and on the flue sheet. In any event, this arrangement presented a greater problem for the cleaning of flues and flue sheets to the extent that this part of the servicing of locomotives was neglected and the locomotives allowed to be used until a poor steaming condition developed before the job was done.

Another recent development, an arrangement applied to New York Central locomotives, is a brick baffle supported on circulator tube near the front end of the crown sheet and extending down from the crown sheet about 15 in. to 18 in. A brick wall is placed in the combustion chamber about 13 in. back of the flue sheet and 15 in. high in the center. This arrangement tends to change the path of the gases from the crown sheet downward and then, by this wall, upward toward the flue sheet, so that this change in direction causes the heavy slag to continue downward and be deposited on the bottom of the combustion chamber and on top of the brick arch. The effect is to eliminate much of the flue stoppage and accumulation of slag on the flue sheet. This presents the problem of removal of the material deposited, but even so is of less consequence and expense than to remove the slag deposited on the flue sheets and stoppage of the flues.

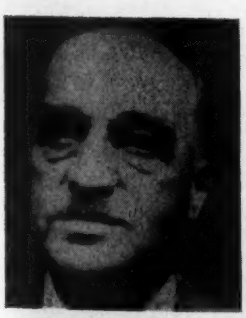
The use of the Dutch oven on oil-burning locomotives described in this committee's report of last year is being further extended on some roads with proved advantages in better steaming as a result of higher firebox temperatures and more efficient combustion. Locomotives are being operated with these ovens with larger exhaust nozzles and some improvements experienced in boiler maintenance. While all of the problems in maintenance of the brick work in these Dutch ovens have not been properly solved, there has been much improvement in this respect and it is evident that further development along this line will continue.

The members of the committee are S. R. Tilbury (chairman), fuel supervisor, Atchison, Topeka & Santa Fe; A. A. Raymond, superintendent fuel and locomotive performance, New York Central System; W. E. Small, Boston & Maine; A. H. Glass, chief power and fuel supervisor, Chesapeake District, Chesapeake & Ohio; G. E. Anderson, general fuel supervisor, Great Northern.

Discussion

In the brief discussion following the presentation of this report it was emphasized that, although members are inclined to show little interest in matters pertaining to steam locomotives, there are a lot of good steam locomotives, many of them oil burning, which are going to continue in service and burn a lot of fuel before the railroads are Dieselized. The Dutch Oven on oil-burning locomotives was endorsed as a fuel saver and a means of reducing drumming.

Education and Duties of Road Foremen



F. P. Roesch, Chairman

In a report prepared by a committee, under the direction of Frank P. Roesch as chairman, the qualifications, education, and duties of road foremen of locomotives were outlined. A high-school education and a thorough knowledge of the locomotives on his railroad should be possessed by the candidate. The committee also stressed the personal qualifications, such as pleasing personality, sound judgment, and capacity to demonstrate proper practice in locomotive and train handling. Reasons were given why road foremen should be selected from the ranks of active enginemen. Young promoted enginemen usually make good instructors; they are better qualified to supervise the handling of locomotives and are familiar with operating department rules. Furthermore, this practice provides a promotion incentive to ambitious young enginemen.

Among the duties of the road foreman set forth in the report are to inform himself of the general condition of all locomotives in his territory, to instruct enginemen and firemen under his jurisdiction as to their duties and to be sufficiently familiar with his men to know their qualifications and abilities. He must correct improper practices and consult the master mechanic and roundhouse foreman with reference to locomotives needing special attention.

Discussion

Eight qualities which should be possessed by candidates for road foreman were brought out by the various members who discussed the report, some of them repeatedly. He must be qualified by experience to handle the jobs on both sides of the cab. He must be an effective instructor. He must be able to get along well with his men and to influence his superior officers. He must be intelligent and quick to learn. He should possess much endurance and patience. If

he is a good speaker he will have opportunity to serve his road by speaking before outside audiences on subjects such as smoke abatement. He must exercise firmness in dealing with his men. He should be young.

At the outset the question of what officer the road foreman should report to was injected into the discussion. On three of the roads represented they report to the division superintendent; on nine they report to the master mechanic. In each case the representatives were strongly in favor of the practice in force on their home road. Two discussers who did not state the practice on their roads took the view that the reporting channel was of less importance than the general willingness to co-operate and the ability of the road foreman to deal with his officer in a way to get what he needed from him.

Frequent comment was heard on experience in training and qualifying steam men for handling Diesel-electric locomotives. The opinion most frequently expressed was that this was not difficult if approached systematically, one thing at a time, and if patience was exercised. All accounts agreed that men are rarely disqualified, unless they are deliberately lacking in interest. One of the problems is training in train handling on divisions where the Diesel has caused major increases in train loads.

Controlling Smoke at Washington Terminal

M. G. Stewart

Our enginehouse on the Washington Terminal consists of two sections with 25 stalls in each section, and our entire property is in the shadow of the Capitol building of the United States. Countless numbers of homes and apartment houses have been erected on vacant lots and areas adjacent to and near the property, making it necessary to rid the vicinity of smoke at all times. This condition has made it necessary for us to become very smoke conscious.

When an engine arrives on the inspection pit at the roundhouse it is the duty of the engineman and fireman to know that the firebox has a medium coked fire. When a fire is left too light it will soon burn out, and will not afford the fire cleaner the opportunity of cleaning the fire properly without running the chance of losing the entire fire. A low fire is also liable to cause the seams and flues to leak. At the same time, if the fire is too heavy cleaning it causes a waste of coal and time.

Forms are furnished the engineman on which it is his duty to report any defects that he has noted in any part of the locomotive. This report, made out by the engineman, is then given the inspectors who then proceed to inspect the entire boiler and firebox, including smokebox equipment and all parts of the locomotive. When they find defects not noted by the engineman they add them to the report in the space provided for them. If the engineman makes out a thorough report and the inspector makes a thorough inspection, the roundhouse foremen are in position to know just what has to be done to this engine before it can be made ready for its next trip.

When the locomotive is moved to the fire-track, see that there is a proper amount of water in the boiler, in order to avoid the use of injectors during the cleaning of the fire, which injures the tubes and seams by the rapid reduction of the temperature of the water in the boiler.

The fire cleaner now proceeds to clean the fire, using the blower as lightly as possible to prevent smoke or back draft; a heavy blower rapidly cools the firebox and the tubes and may cause the seams to leak. If the fire is not too dirty proper shaking of the grates will remove the accumulation of ashes. Otherwise, one-half of the fire, or in cases of extremely large grate surfaces, one-quarter of the fire should be cleaned at a time. Then the fire should be built up sufficiently to bank, when the engine is put in the enginehouse or on the outbound track for repairs or general work. At no time should the stoker be used.

When building a fire it must be remembered that the only place air is received in the firebox is through the ashpan and grates, or through the fire door or induction tubes. It is well known that air enters through the least restricted path, and that is why we emphasize the thought of keeping the fire thin and as uniform as possible.

It is the responsibility of the management to give the firebuilder every known implement or device to assist him in the elimination of smoke.

The boiler should be filled with water, just enough to see in the bottom of the water bottle. When bedding grates, the grate surface, depending upon the size and preparation of coal, should be covered uniformly with three to six inches of fuel. If you are using kindling materials, such as shavings, oily waste, or wood, they should be scattered uniformly over the entire surface, and ignited at several points, in order to cause uniform ignition of the fuel bed. If there is excessive smoke, you may have to change the bedding of the coal on the grates so that you will have a thin layer along the center, gradually increasing the thickness towards the side sheets. With this arrangement, the kindling material should then be put on the thin portion of the fuel bed.

When using an oil torch to light the fire, ignite the fire as far under the arch as possible, and keep the flame localized until the coal is ignited. Then move to another section under the arch and ignite that, gradually working the oil torch back under the arch to the middle of the fire, then to back end of the firebox. This system has been found to be almost fool proof.

Some fire builders have trouble in getting a uniform bedding of coal into a dark firebox. When this is the case, if a small piece of oily waste is ignited on the fire shovel and then placed in one of back corners, it will give sufficient light over the entire grate surface so that one can see to bed the grates properly.

After the fuel is properly ignited, be sure that it is burned to a good coke before adding fresh coal. When it becomes necessary to add fresh coal it should be done only as needed, and applied in small quantities. The blower on the engine should not be opened wider than necessary to supply a proper draft. It will be found that if a Locoblow is used when building a new fire it gives an even draft and eliminates the change over from the house blower to the engine blower. The use of the injector should be avoided until the proper pressure on the boiler is obtained, except when it is absolutely necessary to use it.

If the fire builder can keep the fuel bed not to exceed 6 in. thick and maintain proper boiler pressure by adding a small amount of coal with the shovel he has done a good job in building the fire and eliminating smoke. The hostler should be satisfied now to move the engine to the outbound tracks for the road crew. If it is necessary for the hostler to add some coal to the fuel bed he should do this sparingly. If this is done the engine can be turned over

to the road crew in a satisfactory condition for them to do their work in preparing the engine for the road without making smoke.

The roundhouse forces are now completely finished with this engine. The engine crew takes over.

This engine should not be ordered until the train is ready. After the train is ready the people responsible must see that it is dispatched as promptly as possible. They must see that there are no unnecessary delays. Slow orders and bottlenecks in traffic should be kept to a minimum. Track Supervisors should see that all unnecessary stops are eliminated, because each stop creates a smoke hazard. Each stop increases fuel consumption, thereby increasing the cost of operation.

When the train reaches its destination, those responsible must see that the train is handled promptly and efficiently. That the locomotive is detached promtply and that it is dispatched to the enginehouse with as little delay as possible. When this engine is placed on the pit at the enginehouse it again becomes the responsibility of the enginehouse forces.

I demonstrated a portable smoke consumer at Minneapolis in 1946, which has proved to be one of the most useful devices to admit air into the firebox of a locomotive. This device can be connected to the air line of the enginehouse, or to the brake pipe of any locomotive and, with the air compressor working, can be manually placed in the firebox of any locomotive when building up a new fire or breaking up the fire, getting it into condition for dispatchment.

We on the Washington Terminal, as well as other railroads, who are now using this type of smoke consumer, have found it of great benefit in the elimination of smoke in the enginehouse territory.

The third Wednesday of each month of the year a committee, made up of the officers and smoke inspectors of six railroads, including the Pennsylvania, the Baltimore & Ohio, the Southern, The Richmond, Fredericksburg and Potomac, The Chesapeake & Ohio and the Washington Terminal, along with the smoke inspectors of the District of Columbia, review all smoke violations by the railroads. The railroad involved presents a report of the offense and the steps taken to prevent a repetition. A general discussion is held on conditions in the District of Columbia, and new improvements and suggestions are weighed for the general welfare of the community. On many occasions we have visitors from civic organizations, and from other states. We feel that the insight given people of this type concerning our efforts to eliminate smoke is a great help toward enlightening the general public.

Our Committee has a great deal to explain when a bad smoke condition is noted, because so many miles of trackage run through important residential sections of the city, alongside of big government buildings, and almost up to the Capitol Building itself. This, along with congested conditions, make it necessary for us to keep a watchful eye on smoke conditions at all times.

This report was prepared by M. G. Stewart, road foreman of engines, Washington Terminal Company.

Discussion

The difficulty of laying in a new fire on the grate of a large firebox by the shovel method was brought out in the discussion and several opinions were expressed that in many cases, when close supervision was not at hand, the stoker was actually used even though it did make smoke. Mr. Stewart insisted, however, that the stoker was not used at the Washington terminal. The negro fire builders employed there are tall men who have become expert in shoveling coal into the firebox by hand. A coal bed 4 to 6 in. deep on the grate was advocated as adequate to bring steam pressure up to a point where the locomotive could be moved out of the enginehouse under its own steam without replenishing the fire.

One of the difficulties of igniting the fire without smoke is the weak pressure on many roundhouse blowers. The thin center with the horseshoe bank helps in these cases, a small amount of hand firing being done as the fire progresses to keep up the center section as it burns out.

A source of disagreement between the railroads and local smoke inspectors was said to arise from the difference in the appearance of smoke when seen by the fireman and engineman from the cab and by the inspector from an overhead bridge or roadside location. This is a matter, it was said, needing education. One suggestion was that the railroads secure copies of the Ringelman smoke chart from the U. S. Bureau of Mines and post copies of it where enginemen could see it and become familiar with it. Smoke Prevention Week, to be observed October 23-29, was referred to briefly. A study of the emission of cinders is to be made at the Altoona, Pa., testing plant of the Pennsylvania for the railroads associated with Bituminous Coal Research, Inc., in connection with the smoke ordinance of Allegheny County, Pa., a provision of which is said to require a reduction of 75 per cent in the locomotive cinders within five years beginning October 1, 1949.

In answer to a question, Mr. Stewart said that smoke abatement had resulted in saving fuel on the yard locomotives of the Washington Terminal. He could speak for the road locomotives of the railroads operating into the terminal.

Harry Ballman, smoke abatement engineer of the City of Columbus, Ohio, suggested that the railways should give more attention to what they can do in the way of smoke abatement rather than to dwell on what they cannot do. Coal-burning locomotives, he said, are good locomotives if well maintained with all the auxiliary equipment that is available today for smokeless operation, including a cinder collector not now on most locomotives. Such a locomotive, he said, with a good crew working together and well trained, is cleaner than the Diesel. Diesels, he said, are dirty if they are subjected to the same mishandling and mismanagement that steam locomotives have had for years.

Heating Diesel-Hauled Passenger Trains

Frequently in cold weather on long trains trouble is experienced because the last cars are cold. In most cases the fault does not lie with the steam generators, just a case of running beyond their capacity trying to heat long trains without a reserve or excess amount of steam to call on.

There are tendencies on practically all railroads to add cars beyond their original intentions. When these cars are aded to a train, many times the train itself is considerably longer than it had ever been with a steam engine.

The capacity of the steam generator limits the number of cars that can be successfully heated in winter or cooled in summer. In the same manner, the water-tank capacity for the steam generator limits the distance that may be covered between water stations.

[The report here dealt briefly with the two types of steam generators for Diesel locomotives, the Vapor O.K. type, and the Elesco type. Principal attention was given to the procedure for starting the Vapor type and to an operating description of the Elesco type.—Editor.]

The requirements for heating passenger trains of any

length come back to the amount of steam used per car per hour, which is dependent largely on the speed of operation. The length of train which can be heated depends on the size of the steam line from the locomotive through the train and the insulation of the steam line.

The newer equipment which is now being built with 2½-in. train lines can be heated satisfactorily if the train is limited to the number of cars for which steam can be generated in below-zero weather.

When cars are of the older type with 2-in. train lines, the problem changes because the 2-in. train line does not have sufficient steam-carrying capacity to permit heating a long train. Under maximum conditions the 2-in. train line will conduct steam back to heat properly only a 12 to 14-car train in zero weather at high speed. This is true whether the source of steam be a steam locomotive or a Diesel locomotive with a steam boiler of adequate size. Train-line size and insulation are the limiting factors.

There has been a tendency to add more cars to trains than the boiler capacity is adequate to heat. If the boiler supply is inadequate to furnish the required amount of steam with a proper excess to protect it against emergency, then fewer cars should be handled during severe winter weather, or additional capacity should be obtained by adding to the boilers on the Diesel locomotive.

R. B. Nicholson, road foreman of engines, New York New Haven & Hartford, is chairman of this committee.

Discussion

The opinion of those who discussed this report is that the key to successful passenger-train heating with Diesel locomotives is close attention to maintenance of the steam generators. Another factor is water treated to keep the heating surfaces free from scale. In closing, Mr. Nicholson emphasized the effect of train-line leaks in reducing the effectiveness of heating at the ends of long trains.

Exhibit at Chicago Meeting

During the annual meetings of the Coordinated Railroad Mechanical Associations at the Hotel Sherman, Chicago, the Allied Railway Supply Association held an exhibit of devices for steam and Diesel-electric locomotives and for car equipment. The companies exhibiting are listed below. Officers of the Allied Railway Supply Association were elected for the coming year as follows:

President, B. S. Johnson, W. H. Miner, Inc.; first vice-president, R. A. Carr, Dearborn Chemical Company; second vice-president, C. O. Jenista, Barco Manufacturing Company; third vice-president, W. Lane, Franklin Railway Supply Company, Inc.; fourth vice-president, Frank Moffett, National Malleable & Steel Castings Company; fifth vice-president, J. S. Dixon, Lima-Hamilton Corp.; secretary-treasurer, C. F. Weil, American Brake Shoe Company.

Executive Committee: John Baker, Locomotive Firebox Company; Bard Browne, The Superheater Company; C. R. Busch, Unit Truck Corporation; George L. Green, Spring Packing Corporation; H. C. Hallberg, Waugh Equipment Company; S. W. Hickey, Simmons-Boardman Publishing Corp.; D. I. Packard, Pyle-National Company; F. Rutherford, Vapor Heating Corporation; J. L. Smith, New York Air Brake Company; D. F. Hall, Hunt-Spiller Manufacturing Corporation; A. H. Bickerstaff, Westinghouse Air Brake Company; C. E. Grigsby, American Steel Foundries.

List of Exhibitors

Air Reduction Sales Co., New York
Ajax-Consolidated Co., Chicago
American Air Filter Co., Inc., Louisville, Ky.
American Arch Company, Inc., New York
American Steel Foundries, Chicago
Barco Manufacturing Co., Chicago
Binks Manufacturing Co., Chicago
Briggs Filtration Co., Bethesda, Md.
Buckeye Steel Castings Co., Columbus, Ohio
Cardwell Westinghouse Co., Chicago
Caterpillar Tractor Co., Peoria, Ill.
Champion Rivet Co., Cleveland, Ohio
Champion Transportation Sales, Inc., Chicago
Chemical Appliances, Inc.
Chicago Malleable Castings Co., Chicago
Chicago Pneumatic Tool Co., New York
Chicago Railway Equipment Co., Chicago
Cooktite Ring Sales Co.
Crane Co., Chicago
Dearborn Chemical Co., Chicago
Detroit Lubricator Co., Detroit, Mich.
Duff-Norton Manufacturing Co., Pittsburgh, Pa.
Electro-Motive Div., General Motors Corp., La Grange, Ill.
Enterprise Railway Equipment Co., Chicago
Everede Tool Co.
Fairbanks, Morse & Co., Chicago
Flannery Bolt Co., Bridgeville, Pa.
Franklin Railway Supply Co., New York
Garlock Packing Co., Palmyra, N. Y.
Gerin Corp., Red Bank, N. J.
Great Lakes Steel Corp., Ecorse, Mich.
Guston-Bacon Manufacturing Co., Kansas City, Mo.
H & M Sales Co.
Hanna Stoker Co., Cincinnati, Ohio
Hennessy Lubricator Co., Inc., Chambersburg, Pa.
Holland Co., Chicago
Hulson Co., Keokuk, Iowa
Hunt-Spiller Manufacturing Corp., Boston, Mass.
Independent Pneumatic Tool Co., Aurora, Ill.
Ingersoll-Rand Co., New York
Janney Cylinder Co., Philadelphia, Pa.
Johns-Manville Corp., New York
Joyce-Cridland Co., Dayton, Ohio
Lietz Engineering Co.
Lily-Tulip Cup Corp., Los Angeles, Calif.
Lima-Hamilton Corp., Lima, Ohio
Locomotive Finished Material Co., Atcheson, Kan.
Locomotive Firebox Co., Chicago
Lunkenheimer Co., Cincinnati, Ohio
MacLean-Fogg Lock Nut Co., Chicago
Magnaflux Corp., Chicago
Miller-Felpax Corp., Winona, Minn.
Miner, W. H., Inc., Chicago
Minneapolis-Honeywell Regulator Co., Minneapolis, Minn.
Modern Railroads Publishing Co., Chicago
Modern Supply Co.
Monarch Packing & Supply Co.
Nathan Manufacturing Co., New York
National Aluminate Corp., Chicago
National Malleable & Steel Castings Co., Cleveland, Ohio
New York Air Brake Co., New York
Nugent, Wm. W., & Co., Chicago
Oakite Products, Inc., New York
Okadee Co., Chicago
Oxl Corp., Gary, Ind.
Oxweld Railroad Service Co., Chicago
Parr Paint & Color Co., Cleveland, Ohio
Paxton-Mitchell Co., Omaha, Neb.
Peerless Equipment Co., Chicago
Pilliod Co., New York
Punch-Lok Co., Chicago
Pyle-National Co., Chicago
Railway Equipment & Publication Co., New York
Railway Mechanical Engineer, New York
Railway Purchases & Stores, Chicago
Reed Roller Bit Co., Houston, Tex.
Roebling's Sons, John A., Co., Trenton, N. J.
Rust-Oleum Corp., Evanston, Ill.
Sargent Co., Chicago
Sinkler, Joseph, Inc., Chicago
SKF Industries, Inc., Philadelphia, Pa.
Snap-on Tools Corp., Kenosha, Wis.
Spring Packing Corp., Chicago
Standard Car Truck Co., Chicago
Standard Stoker Co., Inc., New York
Superheater Co., Inc., New York
Superior Hand Brake Co., Chicago
Swanson Co., O. W., Chicago
Symington-Gould Corp., Depew, N. Y.
Timken Roller Bearing Co., Canton, Ohio
T-Z Railway Equipment Co., Chicago
Union Asbestos & Rubber Co., Chicago
Unit Truck Corp., New York
Universal Railway Devices Co., Chicago
Valve Pilot Corp., New York
Van der Horst Corp. of America, Olean, N. Y.
Vapor Car Heating Co., Inc., Chicago
Viloco Railway Equipment Co., Chicago
Warner Lewis Co., Tulsa, Okla.
Watson-Stillman Co., Roselle, N. J.
Waugh Equipment Co., New York
Westinghouse Air Brake Co., Wilmerding, Pa.
Whiting Corp., Harvey, Ill.
Wilson Engineering Corp., Chicago
Wine Railway Appliance Co., Toledo, Ohio

Electrical Sections Have New Responsibilities

The two Electrical Sections of the A.A.R. — representing respectively the Mechanical and Engineering Divisions — hold separate annual meetings and also first joint meeting with the Coordinated Railroad Mechanical Associations

ELECTRICAL subjects of current interest to both railroad mechanical and engineering departments were discussed in triple meetings held in Chicago during the week of September 19, 1949. The Electrical Section, Mechanical Division, A.A.R., held its annual meeting at the Hotel LaSalle on September 20 and 21. The Electrical Section, Engineering Division, A.A.R., held its annual meeting, also at the LaSalle on September 22. There was a joint meeting of the Electrical Section, Mechanical Division, with the Coordinated Railroad Mechanical Associations at the Hotel Sherman on the afternoon of September 21, the subject under discussion being Automotive and Electric Rolling Stock.

At the opening session of the Electrical Section, Mechanical Division, on Tuesday, September 20, Chairman L. S. Billau, electrical engineer, Baltimore & Ohio, welcomed members of the Section and of the Railway Electric Supply Manufacturers Association. He called attention to the enormous increase in the use of electrical apparatus by the railroads, citing the example of the Diesel-electric locomotives which now do 50 per cent of the railroads' switching work, making 55 per cent of the passenger miles and one-third of the freight gross ton miles. There are now more than 10,000,000 hp. of Diesel-electric locomotives in service. Concerning passenger cars, he said that old proceedings of the section showed that axle generators of 4 kw. were the largest needed and that 2 kw. was satisfactory for a coach. Now, he said, there were axle generators of more than 30 kw. in service (probably the limit), and that there were in service in excess of 6,000 axle generators with a rating of 15 kw. or more. Nearly all work done by the railroads, he said, is now of concern to the Section.

J. A. Andreucetti Retires

Following his brief address, Mr. Billau announced the forthcoming retirement of J. A. Andreucetti as secretary-treasurer of the Electrical Section. Mr. Andreucetti entered railroad service with the Chicago & North Western as an electrical helper on May 1, 1905. He continued in the service of this railroad through various promotions, retiring as chief electrical engineer on July 1, 1947.

The Association of Car Lighting Engineers was established in 1908, and Mr. Andreucetti was elected secretary-treasurer in 1910. The name of the Association was later changed to the Association of Railway Electrical Engineers, and in 1937 it became the Electrical Section, Mechanical Division, A.A.R. From 1910 to the present time, Mr. Andreucetti has served continuously as secretary-treasurer, and Mr. Billau stated that it was to a large extent the work of Mr. Andreucetti which has made the Section a successful organization. In recognition of his long and able service, Mr. Billau presented an engrossed, framed resolution from the Section which reads as follows:

> "An appreciation from the members of the Electrical Section, Mechanical Division, Association of American Railroads, to J. A. Andreucetti in recognition of his valuable services to the organization. The Section, as a token of esteem, takes great pleasure in appointing him to the honorary position of Secretary Emeritus. Presented at Chicago, Illinois, this twentieth day of September, 1949.
>
> Lewis S. Billau, Chairman."

Election of Officers

The following list of officers was elected:

Chairman: F. O. Marshall, chief engineer, Pullman Company.

Vice-Chairman (East): W. S. H. Hamilton, engineer electrical equipment, New York Central.

Vice-Chairman (West): L. C. Bowes, electrical engineer, Chicago, Rock Island & Pacific.

Committee of Direction: K. H. Gordon, assistant electrical engineer, Pennsylvania; and D. C. Houston, electrical engineer, St. Louis-San Francisco.

Electrical Section Mechanical Division

Welding and Cutting

Some new classes of electrodes have been added to the A.W.S.-A.S.T.M. specifications for mild steel electrodes, and it was considered desirable to add the information on these to the material already in the Manual.

Specifications have also been issued for corrosion resisting chromium and chromium nickel electrodes. These, the committee suggests, should be in the Manual with the mild steel electrodes. With the advent of the Diesel-electric locomotive, new problems in welding stainless steel have arisen and information on the various types of stainless steel electrodes should be available.

Only the section on stainless steel electrodes is included in the report. Specifications for these electrodes are included in the report. They were developed primarily to classify high-alloy chromium and chromium-nickel welding electrodes. The tests required by these specifications are (1) the chemical analysis of weld metal; (2) the fillet weld test; and (3) the all-weld metal tension test.

Welding of High Tensile Steel

A joint meeting of the members of the Cutting and Welding Committee of the Electrical Section, and representatives of the Truck Manufacturers' Engineers Committee and the Mechanical Committee of the Standard Coupler Manufacturers was held in Chicago early in April of this year and the proposed welding of high tensile steel castings was discussed. Agreement was reached on the following procedure for welding of high-tensile steel:

The Castings should preferably be preheated in a furnace, but local preheating is permissible. If local preheating is employed, the temperature shall not exceed 600 deg. F. to prevent or at least reduce to a minimum any tendency to warp. The welding must be performed while the metal adjacent to the weld is maintained between 300 deg. and 600 deg. F. A Class E-9015 or E-9016 electrode must be employed.

The welded casting shall be normalized at 1,500 to 1,600 deg. F. and tempered at 1,000 to 1,100 deg. F. The casting shall be held at the temperature specified for approximately one hour. Heating the casting to a higher temperature or for a longer time than specified should be avoided because of the undesirable reduction in tensile strength and excessive scaling that may occur.

For castings less than one-inch or less in thickness of known composition, having less than 0.35 per cent carbon and a Jominy hardenability less than 40 Rockell C at $^{10}\!/_{16}$ in., welding may be done without preheat. Welding electrode and post-heat treatment shall be as above.

The Mechanical Committee of the Standard Coupler Manufacturers will revise the welding instructions in Circular 5147 to correspond to these recommendations.

Failures of Evans Auto Loaders

Attention is directed to the increase in freight damage claim payments on shipments of new automobiles and accessories. It is estimated that nine-tenths of the amounts paid out for damage claims is due to mechanical failures in the auto-loader equipment. Furthermore, some of these failures have resulted in severe personal injuries.

As an indication of the constantly rising freight damage claim payments on shipments of automobiles, one of the railroads handling a large volume of this type of traffic has furnished the following figures:

Year	Freight Claim Payments (in dollars)
1944	60,363
1945	66,914
1946	106,853
1947	198,943
1948	265,707

It is assumed a similar trend has been noted on other railroads and that proportionate payments have been made.

An inspection of a large number of failures which occurred in the auto-loader equipment of cars belonging to various car owners indicated that the majority of failures was due to the use of improper welding practices. It is the purpose of this report to call attention to the various items on which defective welding has been noted and to recommend such action as may be appropriate.

Several parts which had been involved in failures were found to have been previously welded although the condition of the part clearly indicated that it was not practical to make repairs by welding.

Defective welds are also noted in chain wheels, cable drums, chain bars, limit levers, hoist braces, frame guides, safety hooks, rack-frame angles and cross channels, chain pans, rear sliding plates, sheave hangers, hub plates, front arm and leg storage brackets, floor tubes, chain links, U-rods and the tubes and forgings comprising the supporting arms and legs.

In the case of broken or fractured rack-frame angles, it is the practice of several railroads to weld fracture and then apply a ½-in. thick angle reinforcement at least 60 in. long on the inside with center of reinforcement angle located at point of fracture. The reinforcement angle is skip welded on both edges but not across the ends.

Many serious failures were noted in the supporting arms and legs due to apparent use of excessive heat in welding or straightening operations. The arms and legs consist of a comparatively thin walled steel tubing having a carbon content of approximately 0.25 per cent and a manganese content of 0.55 per cent. Although steel of this analysis should not present any difficulties as far as welding is concerned, it is found that most failures occur at points where heat had been applied for the purpose of straightening bent tubes.

It was also found that a considerable number of failed welds at various locations had been made by the oxy-acetylene process. It is not the intent of this report to condemn the process used, as it is clearly evident from observation of the failed welds that the welding had been performed by incompetent operators. It is felt that satisfactory results may be obtained with either process, provided the parts are properly prepared for welding and the work performed by a fully qualified operator.

The auto-loader has been developed and constantly improved over a period of years with the result that the frequency of failures in the newer equipment has been considerably reduced. However, there are still a large number of cars in service that are equipped with racks which have been in use for ten or more years. This older equipment must be given careful study to determine its weak points so that parts which are repeatedly failing may be properly strengthened and reinforced.

As all necessary welding work on the auto-loader equipment already falls within the provisions of A.A.R. Rule 23, no changes in the rule are recommended. However, to secure the best possible results when necessary to make repairs by welding and to prevent subsequent weld failures, the following suggestions are offered:

1. None but qualified welding operators should be used.

2. Extreme care should be used when necessary to heat or weld on the tubes of the supporting arms and legs. Straightening of bent tubes without the use of heat by means of a special tool is preferred.

3. When necessary to weld fractured rack frame angles or channels, suitable reinforcement angles should also be applied.

Assuming that due regard is given to the proper handling of the equipment, it is felt that careful observance of the above suggestions, coupled with the use of good judgment on the part of both supervisors and welding operators, will result in a substantial decrease in weld failures in autoloader equipment.

Uniform Welders Certificate

The Committee has provided, in the Manual, methods for qualifying welders. It appeared desirable to also provide a suitable standard form for use by the railroads in recording the results of such qualifying tests.

Such a form is included in the report and incorporates details of various similar forms now in use on various railroads. It provides a record of both the simple Tee bend test as well as the fillet weld soundness test. It covers both electric arc and oxy-acetylene processes.

Since it is important that welders doing work covered by A.A.R. regulations know what these regulations require, a place has been provided for the results of examination covering the A.A.R. rules pertaining to welding.

Titles for the examining and approving officials have been omitted as the individuals will vary from one railroad to another.

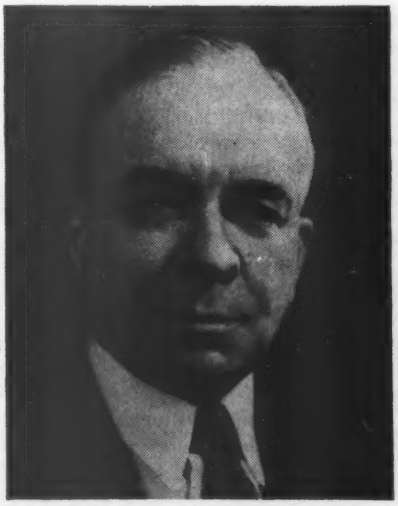
It is believed that the use of this certificate by all railroads will help to insure that the welders engaged in interchange welding will be properly qualified. It should also simplify the work of the A.A.R. inspectors in checking welder's qualifications.

The report states that a welder should be instructed in the safe handling of welding equipment before he is assigned as an operator. Listed in the report are rules with which he should be thoroughly familiar before he is considered a qualified operator. It is recommended that all regular operators be required to pass a satisfactory safety rule test before assignment.

Electrical Section—Engineering Division Association of American Railroads

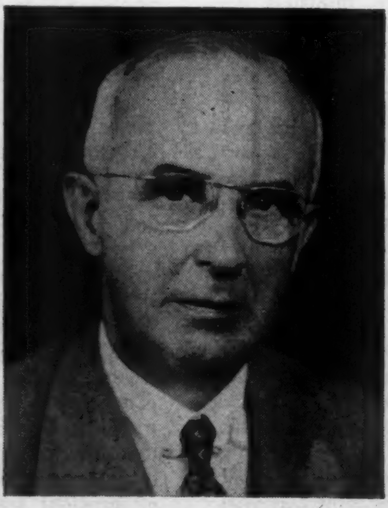
Officers

L. S. Billau, *Chairman*, electrical engineer, Baltimore & Ohio, Baltimore, Md.
F. O. Marshall, *First Vice Chairman*, chief engineer, Pullman Company, Chicago
W. S. H. Hamilton, *Second Vice Chairman*, engineer electrical equipment, New York Central, New York
J. A. Andreucetti, *Secretary*, Electrical Section, Mechanical Division, A. A. R.



L. S. Billau

F. O. Marshall



J. A. Andreucetti

W. S. H. Hamilton

The report is signed by L. E. Grant, (*chairman*), engineer of tests, Chicago, Milwaukee, St. Paul & Pacific; J. Michne, welding instructor, New York Central; Frank Hayes, general foreman blacksmith shop, Illinois Central; M. A. Herzog, chief chemist, St. Louis-San Francisco; Frank A. Longo, general boiler inspector, Southern Pacific; B. G. Wollard, welding instructor, Chicago & Northwestern; Robert Moran, welding supervisor, Missouri Pacific; John Hengstler, supervisor of welding, Pennsylvania; and H. A. Patterson, supervisor of welding equipment, Atchison, Topeka & Santa Fe.

Discussion

The report was presented by L. E. Grant, engineer of tests, Chicago, Milwaukee, St. Paul & Pacific. C. A. Williamson, electrical engineer, Texas & New Orleans, stated that the American Standards Association has prepared a pamphlet on safety which is now being revised and suggested that the committee might take this into consideration. Mr. Grant replied that the portion of his report supplied by Frank Hayes, general foreman, blacksmith shop, Illinois Central, had been presented only as information, and that if it should be written into standards, the A.S.A. report will first be consulted.

Motors and Control

At the end of the war, users of all kinds of electrical motors and equipment were anticipating new and improved designs and products which would utilize the knowledge in engineering and manufacturing processes gained as a result of the war effort.

A survey was conducted by the motor divisions of different electrical manufacturers among a large number of motor buyers and users to learn exactly what was wanted in motors.

The results of the survey and the outcome of continuous and intensive studies of the changing motor requirements of industry revealed that any future or ultramodern motors should have the following features: Compactness, more protected enclosures, improved windings, extra protection against electrical breakdowns, freedom from vibration, extra protection against excessive wear in operation, maintenance free bearings, and quiet operation.

New motor designs have been introduced incorporating all of the above characteristics. The new designs include steel construction for extra mechanical strength, insulation designed for greater electrical strength, compact design, lighter weight, streamlined with better mechanical enclosure and smoother operation. Some companies are manufacturing motors with pre-lubricated sealed bearings, requiring no additional lubrication for five years in the larger sizes and for the life of the bearings in smaller sizes. Some makes of motors have identically the same stator cores and frame assembly, regardless of whether the motor is dripproof, splashproof, totally enclosed fan cooled or totally enclosed nonventilated. Coil windings are insulated and treated better to insure against electrical breakdowns. Rotors are dynamically balanced to eliminate vibration.

One manufacturer has introduced a new design called the axial gap motor. This motor has a minimum of parts, effectively reducing weight and space required and providing simplicity of mounting on certain applications.

There has been manufactured recently an a.c. motor, 3,000 h.p., 60 r.p.m., designed for direct connection to a drum on a hoist for mine work; a departure from the usual geared connections. This is the largest motor of this type ever built.

Pre-lubricated Bearings

"Pre-lubricated bearing" is an expression now used to designate an anti-friction bearing which is packed with a lubricant, and sealed with detachable seals, with the idea that no further lubricant attention need be given during the normal life of the bearing.

Obviously a successful bearing lubricant arrangement of this type would be a boon to all motor maintenance men and to those responsible for such maintenance attention.

One of the leading motor manufacturers now offers a line of electric motors fitted with pre-lubricated ball bearings. One type has been in use eleven years on lint-free motors; another on non-ventilated 55 deg. C. rise motors for eight years; and another on a newly designed general purpose motor for three years.

The manufacturer in question secured reports from 114 diversified plants operating a total of 131,626 a.c. motors ranging from one to 50 hp., an average of 1,154.6 hp. per plant, and located in every geographical section of our country.

The data assembled from those reports shows that 19 per cent of all motor failures were due to improper lubrication or lack of lubrication. Reported failures of pre-lubricated bearings were about one-third of non-sealed bearings, indicating that around 13 per cent of all motor failures can be eliminated by the use of pre-lubricated bearings.

In view of the fact that pre-lubricated bearings have not been in general use to any great extent, except for a year or two, this report is submitted only as information; with the recommendation that the subject be continued for further study next year.

Testing Procedures in C.,R.I. & P. Traction Motor Repair Shop

There are two primary functions to be performed in testing traction motors that are sent to the shop for overhauling.

First, to test the various parts for wear, alignment, clearances, fits, etc., such as axle support bearing fits, axle support alignment, axle support lateral, nose support wear, gear case arm support wear, various covers, frame head or bearing housing fits, condition of axle cap bolts, nut and lock washers, motor leads, clamp, terminals, bushings, or practically every part of a motor that is removed when stripping; and in addition, the various fits and clearances given by the manufacturers for each particular type motor.

There should be a form prepared, listing all the various tests, with space left for the mechanic who made the test to sign, and to list what repairs are required, with another space left for the signature of the mechanic who made the repairs. It will speed up these tests considerably if, instead of trying to take these various measurements with micrometers, Go and No-Go gauges, templates, etc., are used. These tests will take approximately two hours per motor, including the distribution of the various parts to the place in the shop where the parts will either be repaired or applied to the motor. Any parts beyond repair should be replaced and distributed by the mechanic who performs the tests.

It will speed up the amount of work involved and save much of the supervisor's time if drawings are prepared showing the shop limits. As the volume of motors through the shop increases, it is going to be impossible to remember all these limits and men will lose considerable time each day looking up the many limits. If these drawings are prepared, as the questions arise, they can be answered. This will also provide complete control of repairs, as every mechanic will be working toward the same end. It also has one other very large advantage, in that, it limits the amount of questions asked by mechanics and cuts out completely two or three mechanics getting together and deciding what

repairs are required. In other words, it eliminates excuses and keeps the man on the job, for this drawing should tell him exactly how to repair the part.

The other, or second test, is to find out what mileage is left in an armature or set of field coils and whether the fields should be removed or armature rewound. We found that a lot of time and money was being spent on motors and then they failed on the final test while still in the shop, or else failed after short mileage in service. To avoid this type of failure, we started increasing the severity of the test until we were almost sure that an armature that was given these various tests would not fail on the final shop test. The value of these tests will have to be decided by each individual railroad, as there are a lot of variables to be considered, such as mileage at which motors are shopped, whether the terrain is level or hilly, the ambient temperature through which locomotives operate, how close each railroad watches tonnage, speed at which train operates, maintenance of equipment in service, etc.

We started out giving each armature a 500 volt di-electric for one minute, and as motors still failed we gradually increased the voltage to the point where an armature that stood the test did not fail on final test. This test was given in the shop before anything was done to it, and four years were required to arrive at a definite test value. We started this test because we were having a very large percentage of repaired traction motor failures in the shop. Before we finally arrived at any value we found that to duplicate actual operating conditions, we first had to operate the motor so that the centrifugal force would make the coil take the same position it had when in service. The first thing we found with these tests on one manufacturer's motors which were failing on the pinion end, was that the taper on the aluminum end bell was not allowing the coils to shape themselves to the taper, so we eliminated the taper and used a straight mica ring. Second, we found that armatures were failing because the solder in the commutator risers was heating and throwing out, and by increasing the voltage on our test, we found that the compound placed between the top of the coils at the commutator riser was carbonizing, and in turn putting a high resistance short between turns just behind the riser. We removed the compound on all motors that were in service as fast as they came to the shop and omitted it on rewound armatures. Leaving this compound out, cut down throwing solder about 90 per cent, and when we have a failure now, the solder throws clear of the riser and causes no trouble, where before when the solder melted and threw out it lodged behind the compound and shorted the armature bars, resulting in failure.

After we had eliminated the shop failure we started working on short mileage motors, and found that armature coils became loose after very short mileage. In order to get coils tighter in the armature we started re-rolling bands.

After eliminating armature failures, we started having a considerable number of open field coil terminal connections, and we tried every test we knew of or could get anybody to recommend for detecting this condition, and none of them proved satisfactory. In order to eliminate this type failure we are now silver soldering all field coil connections, the connection to the field itself, remove the terminals and silver soldering the leads directly on each other, as well as motor leads. The only metal to metal bolted contact we now have is the connection to the brushholder and we have increased the contact area by about 50 per cent, eliminated the stud and applied ⅝-in. cap screws.

This explanation is given so that the test procedure listed below can be understood.

1.—Run motor to 2,000 r.p.m. on 250 volts d.c. and look for vibration, rough commutators, bearing and friction noises.

2.—Take megohm reading of complete motor, using a motor driven megohm meter until reading becomes stable, usually about one minute (a hand driven megohm meter seems to give a false reading). If reading is 100 megohms or over, proceed to Test 3.

3.—Apply 1,050 volts di-electric test for one minute to Electro-Motive Division motors and 1,200 volts for one minute to General Electric and Westinghouse motors. If reading is less than 100 megohms, locate the defect and either disconnect or short out by grounding.

4.—Dismantle the motor completely and fill out form described in second paragraph.

5.—Put all parts through the vapor degreaser. There seems to be opposition by some motor manufacturers to the use of vapor degreasers for cleaning electrical equipment. This can be expected as the varnish used by these manufacturers will be removed, but if you consider that all the action of a vapor degreaser is strictly surface action, then what varnish is removed will be replaced by impregnation before it leaves the shop. We have had our degreaser in operation over five years and some of our motors have been through the degreaser five times. The question is asked what effect the degreaser will have on some so-called silicone coils. We have been using a larger percentage of silicone insulation in our armature coils for several years than is now used on some silicone coils, without any detrimental results. What effect the degreaser would have on 100 per cent silicone I cannot answer, for we only tried one set of 100 per cent silicone insulated coils, and this set failed before it had completed one mileage. It appears from a visual inspection that the silicone provided no abrasive resistance at all, and the winding failed after very short mileage from excessive vibration. By using a little discretion I do not believe the degreaser would have any bad effect of 100 per cent silicone coils. It takes approximately eight hours labor to clean a motor by any manual method, and the degreaser, being automatic in operation, takes approximately 15 minutes, simply to load and unload. It is effective in removing moisture and it normally takes 24 to 72 hours to bake moisture out of a water-soaked generator, whereas the degreaser will remove the moisture while the motor is being cleaned on about 90 per cent of the equipment. It may be necessary to give large generators several cycles. In order to get the benefit of both cleaning and moisture removal, it will be necessary to use a solvent with a higher boiling point than water. Tetrachlorethylene which has a boiling point from 249.8 deg. F. depending on the oil concentration is used in the degreaser.

6.—Give each armature a bar-to-bar test using a high current circulated through the armature and with a milli-volt meter read voltage drop. We pass armatures with five per cent variation. We use an instrument called a Ductor because it is self contained and easily moved. Any loose or high-resistance connections are corrected before being given any further test. If broken bars are found the armature is rewound, and if not more than five per cent of cross connectors are found broken, the armature is put back in service.

7.—Run armature over high frequency test machine (so far all the tests given the armatures have been for ground insulation), to test the condition of insulation between turns or bars and between coils. We use a spark gap type high frequency machine. This machine is capable of impressing 8,000 volts at a frequency of 0 to 180 kilocycles.

All armatures are given an initial test of 2,500 volts or 1,200 volts between coils and 50 volts per bar. At this time it should be noted that we are still trying to find out what mileage is left before doing any work on an armature and each road will have to decide the value required. We are not fully satisfied that values are correct as we still get a few armature failures in service, but every time we change the test value, it takes from one to two years to tell the result of the change. The manufacturer of the test outfit would not

supply any test values as our methods and practices are not orthodox, and without the use of the degreaser to remove the grease and moisture any test at this time would certainly destroy the winding.

8.—Armature is inspected for loose bands and wedges. New bands are applied at every third shopping, or before, if found loose. Wedges are not replaced when loose, as applying new wedges without temporary banding did not correct the looseness, and if temporary banded some of the armatures failed on final test; so unless wedges are burnt we depend on the varnish to tighten them. All temporary banding is done hot and rerolled.

9.—If the armature passes all the above tests, it is vacuum impregnated.

10.—The armature is now given a 2,500-volt di-electric test for one minute. This may look like a very severe test but our percentage of failures is low, not over one out of 100 armatures.

11.—The armature is now run over the high frequency machine and Electro-Motive Division motors are given 4,000 volts or 2,000 volts between coils and 133 volts between bars, and General Electric and Westinghouse motors 4,000 volts between coils or 80 volts between bars.

12.—The armature is dynamically balanced.

13.—The commutator is ground on its own bearings at 1,800 r.p.m. with a stationary stone. After grinding, the commutator is tested for loose bars by holding a brush lightly on the commutator surface and any looseness, regardless of how small, can be detected.

Field or Frame Inspections

1.—The frame is put through the degreaser with field coils intact.

2.—The field coils are removed at 750,000 miles or at the third shopping. If the insulation shows signs of heating or cracking, they are reinsulated. We use mica and glass tape as we found that neither the cotton nor asbestos tape held up without drying out and cracking. We have had glass insulated tape in service for six or seven shoppings without showing any signs of either heat or cracks. We have been changing out all field coils at the third shopping for passenger and freight and at eight years for switching service motors. As the glass tape has held up so well, we do not believe it will be necessary to change out field coils on a mileage basis after all our coils have been re-insulated. All coils that are removed are run over a transformer (growler) for testing for shorts. If shorted, they are removed and the coils are vacuum impregnated and then taped. After being taped they are vacuum impregnated twice. The first time they are only baked long enough to remove the tackiness of the varnish, and the second time they are given a full cycle. This is done to get a heavy coating of varnish. Then after drying and cooling we spray each coil with an exceptionally heavy coat of oil proof lacquer.

We had considerable trouble with loose inner poles on one make of motors, but we corrected this trouble by bending the top washer into a spring and welding to the pole piece. The manufacturer has since come out with instructions to weld this washer but never said anything about bending the washer to get increased pressure.

3.—Field frames which do not have coils removed are given a visual inspection for overheated terminals and a reading of the resistance to try and locate the source of trouble, but no test we have used has proved satisfactory. One manufacturer has eliminated the trouble on a new design of motor, but we believe they will have to apply a flexible connection between coils. Another manufacturer has experienced trouble with broken bus copper on several of its motors, on which they use practically the same type of connection.

To get away from these loose terminal connections on various types of motors, we are silver soldering all the field coils and motor lead connectors together, eliminating entirely all copper to copper connections except at the brush holder.

4.—The field frame is next given a 2,500-volt di-electric test for one minute.

Brushholders

1.—On one make of motors, a boss is silver soldered to both sides of the brush holder body and a longer shaft applied so that three cotter pins can be applied instead of one as on the original brush holders and two on the second design. We had a good many motor failures from this shaft breaking and working out against commutator risers.

2.—Remove the slotted head bolt to which the brush pig tail shunt is fastened. We did this as the slot would not allow a large enough screw driver to be used to get the amount of torque required to tighten this bolt, and we were having motor failures because of loose pig tails and bolts cutting and shorting commutators.

3.—Tighten brush holder carbon way by applying a 0.010 in. oversize steel block and closing in the metal.

4.—Inspect and replace all broken or burnt porcelains.

5.—Seal around porcelain with oil proof lacquer.

6.—Apply 4,000 volt di-electric for one minute. We had too many grounded brush holders after short mileage and this high di-electric test has stopped it.

Use of Infra-Red Lamps Versus Oven Baking

It is the consensus of opinion of the major electrical companies in rewinding and conditioning Diesel-electric locomotive traction motor armatures and generators, that vacuum drying and oven baking processes are preferable to the use of infra-red lamps, which contention is borne out by the opinions evidenced in a survey of various railroads, which accompanies this report.

The chief objection to the use of infra-red lamps is the fact that each size armature requires a separate arrangement due to the difference in diameters, and they do not lend themselves to quantity production. The heat from the infra-red lamps is very intense and rapid, consequently they do not give even distribution of heat throughout the armature mass.

Care should be exercised to avoid surface temperatures that will be injurious to the insulation.

Infra-red lamps can be used advantageously in shops where the infrequent use of baking equipment does not justify the expenditure for baking oven equipment. Infra-red lamps are used extensively also in automotive industries and in places where surface drying alone is required.

When using ordinary electric or steam heated ovens, the use of forced ventilation is most important in order to bring up the temperature much more rapidly and to remove solvent vapors. Then modern baking ovens have recirculating fans that assure even temperature distribution at all levels and are equipped with high capacity heaters that will bring the armatures up to baking temperature in a minimum of time with the high volume of re-circulated air that assures maximum heat transfer. In addition, a regulated quantity of fresh air is introduced to insure correct baking and removal of solvents from the varnish.

The oven baking should first be supplemented by a vacuum-pressure process to prepare the armature for required dipping and baking.

There is a comparatively new process developed that appears to have considerable merit, known as the Zanderoll process of impregnation which lends itself to either infra-red lamps or modern baking oven procedure, merits investigation for production line shops, and utilizes either baking oven, infra-red lamp, induction or resistance heating methods.

The foregoing statement is based on replies to a questionnaire sent out by the committee.

Facilities for Repairing Traction Motors and Generators

In order to provide adequate space and equipment for repair and overhaul of Diesel locomotive traction motors, generators and auxiliary equipment, the Southern placed in operation a complete new shop at Atlanta, Ga., early in 1944.

The building proper was 82 ft. wide by 160 ft. long with an addition on one side 19 ft. wide by 40 ft. long housing office and tool room and an addition on the other side 10 ft. wide by 80 ft. long housing various items of equipment. A center row of columns separates the building lengthwise into two bays, a high bay with runway and ten ton crane and a low bay served by jib cranes. Tracks were provided so that railroad cars could be placed inside the building for loading and unloading heavy material.

The equipment installed in the original layout comprised a full set of machines for traction motor and generator work including a Dynetric balancing machine, vacuum impregnating outfit, armature machine for banding, hypot test set, bake oven, with necessary tools, accessories and testing devices.

At that time the Southern and associated companies owned 89 Diesel units of all classes and it was contemplated that all basic overhaul and rewinding work on traction motors, main generators and auxiliary generators would be handled in this shop for the entire system. Total output and estimated savings were based on handling 30 motors or generators per month.

The number of Diesel units on the system has now increased to 523 with a consequent increase in the number of motors and generators to be overhauled or rewound. The original layout was well planned, however, and this shop is now handling approximately 75 motors and generators per month, rewinding an average of six armatures per month. Two additional bake ovens were purchased and a five ton crane installed in the low bay, but otherwise the original equipment proved to be satisfactory and adequate. This output represents peak capacity for the building and equipment.

It is expected that the required shop output will reach 90 basic overhaul and 20 rewinds per month for traction motors and main generators within the next year. A careful study was made to determine what would be needed to handle this volume of work in the way of space and equipment, with allowances made for future increase in event more Diesels were purchased and the railroad completely Dieselized.

The original layout did not provide adequate space for dismantling and cleaning a large number of motors or generators at one time. A decision was made to purchase a vapor degreaser and to construct an addition approximately 42 ft. wide by 70 ft. long connecting the original traction motor shop to an existing building formerly housing the blacksmith shop. The blacksmith work will eventually be relocated and space 80 ft. wide by 250 ft. long will be available to supplement the space in the original shop and the new addition.

A building at the other end of the traction motor shop 90 ft. wide by 135 ft. long, formerly housing a flue shop, has also been reconditioned and assigned to Diesel locomotive electrical work.

A plan drawing included with the report shows the layout of the original shop, an adjoining building used to house the electrical storehouse, and a shop for the overhaul of small motors and parts. A second drawing shows the arrangement of machinery and equipment in the new extension and proposed addition.

The layout is presented as information and offers a repair shop layout designed to utilize existing buildings without an excessive expenditure. It illustrates the size of a facility required on a railroad operating from 500 to as high as 1,000 Diesel units. The layout may also be adapted to suit a much smaller operation.

The original shop was described in the May and June, 1945, issues of *Railway Mechanical Engineer*.

The report is signed by the Joint Committee on Motors and Control, made up of the following members from the Electrical Section, Mechanical Division: R. H. Herman (*chairman*, joint committee, and *chairman*, Electrical Section, Mechanical Division), engineer shops and equipment, Southern; G. O. Moores, assistant engineer, construction and maintenance, Baltimore & Ohio; C. F. Steinbrink, electrical foreman, Chicago, Rock Island & Pacific; J. R. McLaughlin, assistant electrical engineer, Pennsylvania; and also the following members from the Electrical Section, Engineering Division: A. P. Dunn (*chairman*, Electrical Section, Engineering Division), electrical foreman, New York Central; J. O. Fraker, general electrical and shop engineer, Texas & Pacific; P. W. Pleasant, electrical supervisor and chief fire inspector, Chicago, Indianapolis & Louisville; H. E. Preston, power supervisor, Illinois Central.

Discussion

The report was presented by R. H. Herman, engineer shops and equipment, Southern, and C. F. Steinbrink, electrical foreman, Chicago, Rock Island & Pacific.

Mr. Steinbrink said it is necessary for railroads to make many short cuts, such as the manufacturers use, to reduce the cost of overhauling traction motors, and he recommended that information be compiled covering them.

J. A. Andreucetti, secretary-treasurer, Electrical Section, suggested that improved practices be reported by the railroads using them, and that bulletins covering these practices be sent out by the association.

Roy Liston, mechanical inspector, Atchison, Topeka & Santa Fe, offered the suggestion that if a committee would visit shops to obtain such information, it would constitute a more workable method. Mr. Steinbrink approved of this, saying it is difficult to get answers from railroads to questions on such subjects.

R. L. Griffith, division electrical foreman, Illinois Central, asked if the Rock Island had condemning limits for traction motor bearings, and Mr. Steinbrink replied in the affirmative.

Mr. Herman asked if vacuum impregnation is necessary when a motor goes through general overhaul, but is not rewound. He added that one manufacturer says silicone-insulated motors are not to be vacuum impregnated. He also offered the opinion that they should be. W. S. H. Hamilton (N. Y. C.) said that when a motor is put through an overhaul, it is not cleaned like a new one, and said that in his experience, dirt is bound in by impregnation. Mr. Herman said that vapor degreasing removes both dirt and moisture, and Mr. Steinbrink added that it does a real job of cleaning. N. J. Greene, National Electric Coil Company, stated that his company has tried impregnation, and it is his belief that, if a degreaser is used, and the armature is then blown out with air, and further cleaned with a blast of powdered corn cobs (a process which polishes and absorbs grease), a good job of cleaning has been done. He added that in his opinion armatures last longer with vacuum impregnation because they take more varnish when they are dipped. "Our current practice," he said, "is vacuum impregnation."

J. A. Bucy, supervisor, car lighting, Baltimore & Ohio, said there was need in the air conditioning field of a compressor with sealed-in motor of more than 2 hp. He suggested that the committee should investigate the making of such a motor. His suggestion was referred to the Committee of Direction.

Locomotive Electrical Equipment

The Committee investigated methods of eliminating vibration and shock from headlight cases and sockets quite thoroughly and, from the several devices described in detail in the 1947 report, the following have been selected to offer for inclusion in the manual:

The committee prefers the term "reducing" shock rather than "elimination" of shock, for reasons which should be obvious.

Reducing Vibration and Shock in Headlight cases and sockets

Shock absorbing rubber mounting devices for headlight cases, with the rubber in shear, are shown in Fig. 1. The weight of the headlight case should be evenly distributed on the suspension points located as closely as possible to the center of gravity axes of the case. This method is preferred to that shown in Fig. 2, which may be used for low cost application to existing headlight cases.

Figure 3 shows a headlight reflector with socket assembly mounted on rubber or rubber and fabric diaphragm in shear, with the vibrational frequency of the diaphragm designed at the most favorable frequency to minimize lamp filament damage. This type is also applicable to screw base lamps.

Sealed-Beam Headlights

Reference is made to the 1947 and 1948 reports for development prior to this report.

Some twenty or more additional units have been placed in experimental service during the past year. Some of these units were arranged with the two lamps mounted one above the other instead of side by side as in earlier applications. It is understood the vertical arrangement was commented on favorably by enginemen, in that the light spread was reduced.

Pickup tests are scheduled to be made.

A.C. Turbo-Generators

No development of new types over and above those described in the 1947 report has come to the attention of the committee.

Two inductor type alternators of 500-watt capacity, 380 cycles, 32 volts, have been applied by one railroad. These have been in service about six months with satisfactory results.

Ventilated selenium rectifiers are used with these machines for d.c. power for train control.

The proposed recommended practice covers after trip and monthly inspections. It is not deemed practical to attempt to cover repair, adjustment or calibration procedures for the several types and models in use.

Maintenance of Beam Warning Lights

After Trip Inspection

Make complete test and note that both red and white signals light and that lights are of proper brilliancy.

Note that mechanism moves freely, uniformly.

Note that switches work freely and make proper contact.

Correct all defects that would interfere with proper operation of warning signals.

Warning Light Mechanism, Case and Control Apparatus

Remove light mechanism case cover and check all moving parts for wear and alignment.

Replace any gears, shafts, pins, or other parts worn to interfere with normal operation of signals.

Check relays for worn, burned or corroded contacts, loose connections and other defects that would interfere with proper operation.

Check wiring for worn or broken insulation, also for broken copper strands, particularly at terminals.

Check all terminals and binding posts for loose binding screws or loose nuts.

Clean all parts of mechanism thoroughly.

Clean and polish reflectors if necessary.

Remove switch covers and check contacts for wear, burns or corrosion.

Check wire terminals and binding posts to know all wire connections are tight and in good condition.

Motor Generator

Check motor generator set, if used.

Note condition of commutators and brushes.

Note that brush holders are tight and in proper position.

Note that wire terminals are tight and that wiring is in good condition.

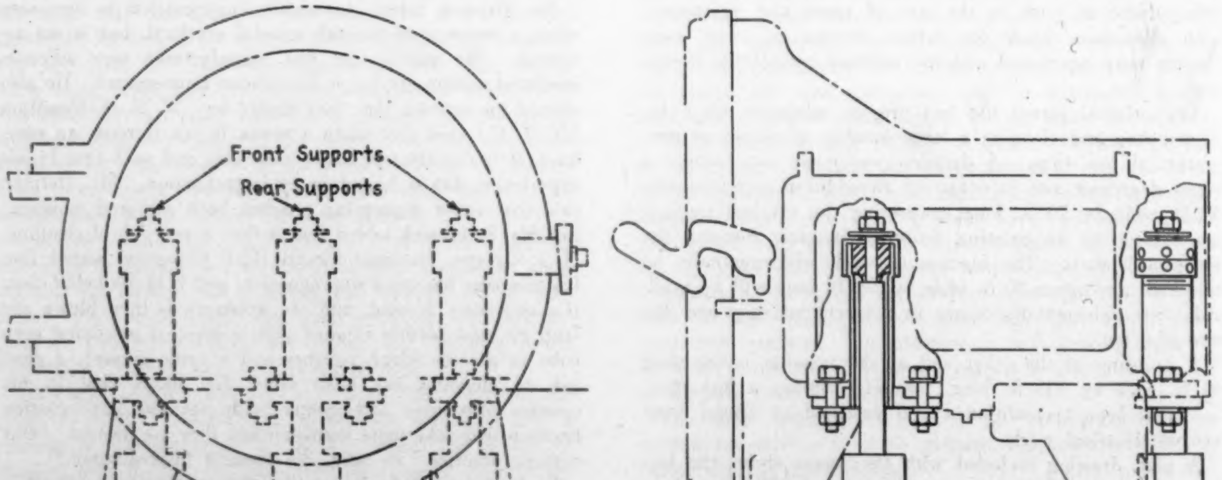


Fig. 1—Headlight cases— Method No. 1—Shock absorbing rubber mounting devices, with the rubber in the shear— The weight of the headlight case should be evenly distributed on the suspension points located as closely as possible to the center of gravity axes of the case—This method is preferred to Method No. 2

Renew brushes if worn to condemning limit established by carrier.

Clean commutators if necessary.

Check bearings for wear.

Make complete operating test to know that warning lights function correctly.

Check output voltage of motor generator.

LUBRICATION

Lubricate all bearings and other wearing surfaces in accordance with special instructions established by the carrier.

The report is signed by A. D. Whamond (*chairman*), foreman, Office of Electrical Engineer, Pennsylvania; Roy Liston, mechanical inspector, Atchison, Topeka & Santa Fe; C. W. Nelson, electrical engineer, Chesapeake & Ohio; W. G. Switzer, assistant engineer, New York Central; R. G. Thompson, assistant chief mechanical inspector, New York, New Haven & Hartford; and A. C. Zagotta, supervisor cab signals and locomotive electrical equipment, Chicago, Rock Island & Pacific.

Discussion

The report was presented by C. W. Nelson, electrical engineer, Chesapeake & Ohio. W. S. H. Hamilton (N. Y. C.) explained that Figs. 1 and 3 are those used on N. Y. C. locomotives, and were standard prior to the coming of the sealed-beam lamp. It has been found, he said, that the mounting shown in Fig. 3 was not sufficient by itself and that shock absorbing mounting of the case was also necessary with the case mounted at its center of gravity.

J. A. Bucy (B. & O.) asked if any specific data has been made available on the life of sealed-beam lamps. Mr. Hamilton replied that the New York Central has most of its Class S21 locomotives equipped with them, that one lamp went 10½ months, and that the average life is 3 to 6 months. He added that 4 months life is necessary to justify the use of sealed-beam lamps. He also called attention to the fact that load is 400 instead of 250 watts, which makes careful attention to voltage and wire sizes necessary. Maintainers' voltmeters, he said, are often inaccurate. He expressed the opinion that the new lamps will come into use, but that close attention to lamp voltage is very important.

Mr. Hamilton asked if vertical or horizontal mounting of lamps made any difference in the beam pattern. After considerable discussion of this matter, in which members said that enginemen preferred vertical to horizontal mounting, H. H. Helmbright, General Electric Company, explained that the relative position of the two lamps made no appreciable difference, but that some difference was caused by the position of the filaments. The present lamps, he said, have a beam pattern which has a spread of 8 deg. in one direction and 10 deg. in the other. With filaments mounted at 90 deg. to each other, the beam has the same width and height, and when the two filaments are vertical, the vertical spread is 10 deg. and the horizontal 8 deg. He also said that consideration was being given to the production of a lamp with a spread of only 7 deg. in each direction. This presumably would somewhat increase the pick-up distance.

Concerning the use of rectifiers with a.c. generators, Mr. Hamilton stated that his railroad has tried a ventilated selenium rectifier and 400-cycle generator for train control power supply and that there has been no rectified failure. A previous report indicated that enclosed, oil-cooled rectifiers which are more expensive, might be required. The manufacturer of the ventilated rectifier states that railroad requirements are mild as compared with army requirements for tropical countries. This claim, Mr. Hamilton said, has so far been justified.

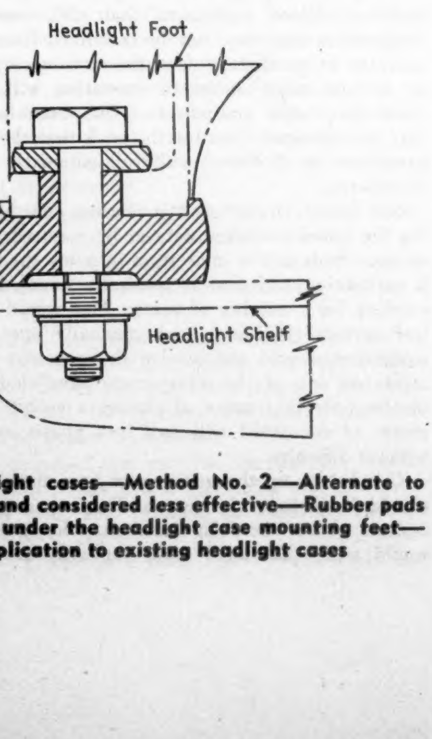


Fig. 2—Headlight cases—Method No. 2—Alternate to Method No. 1 and considered less effective—Rubber pads in compression under the headlight case mounting feet—For low cost application to existing headlight cases

Radio and Communicating Systems

The Committee has been represented at all meetings of Communications Section Committee Four, "Radio and Allied Communications as applied to Railroad Operations." Committee Four appointed a sub-committee consisting of L. R. Thomas, Santa Fe; G. M. Brown, New York Central, and P. B. Burley, Illinois Central, to cooperate with the Electrical Section committee in preparing specifications for satisfactory installation and operation of intra-train telephone systems on passenger cars.

The committee met with this sub-committee and manufacturing representatives and assisted in the preparation of the following specifications:

Since trouble is being experienced with radio and communications jumper cables wearing out due to flexing and working with train movement, it is the recommendation of the joint committee that the specification for this cable as shown on Page ESA-55-1949 in the Manual of Standard and Recommended Practices be modified. The following sentence should be added at the end of paragraph seven of this specification:

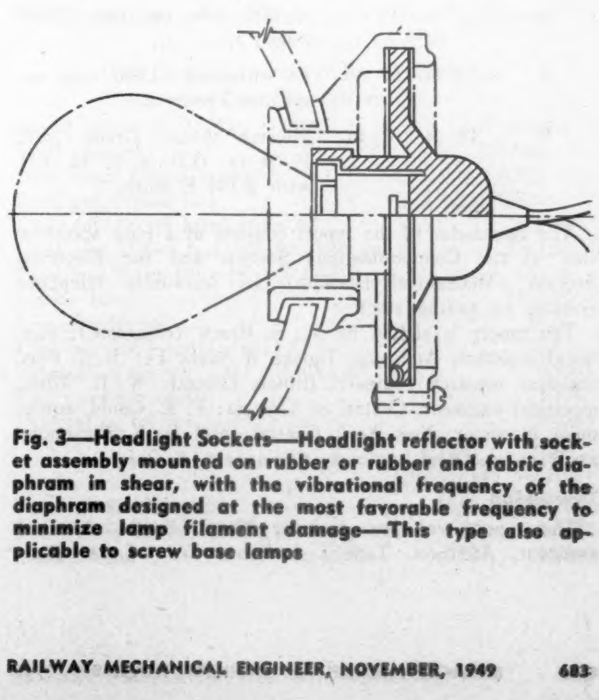


Fig. 3—Headlight Sockets—Headlight reflector with socket assembly mounted on rubber or rubber and fabric diaphram in shear, with the vibrational frequency of the diaphram designed at the most favorable frequency to minimize lamp filament damage—This type also applicable to screw base lamps

"This shield insulation shall be so applied as to fill up the voids in the shield braid and be completely bonded to the same."

A letter sent out by the committee to a number of railroads, asking for opinions on clearance heights and insulation requirements for broadcast receiver antennas used on electrified railroads. The results are given in the following tabulation:

Railway Reporting	Max. Clearance Height Above Rails	Insulation Antenna to Ground
1	16 ft.	Suggest radio antenna be protected against lightning and contact with high voltage lines by suitable ground gap or high voltage condenser or by both instead of depending on insulation applied to radio antenna.
2	15 ft.	Insulation between set and antenna should be designed for 3,000 volt protection with suitable fuses and grounding.
3	15 ft.	The antenna insulation protects its conductor from contact with overhead power lines to the extent of 100,000 volts.
4	Not above the published load clearance diagram for the sections electrified.	Not definitely established. Establish at least 5,000 volts by antenna supports and in addition the antenna could be protected by fibre duct or wood trunking and electrically by an air gap to ground antenna in case of accidental contact of 5,000 volts or more.
5	15.75 ft.	Twice operating voltage of overhead line plus 1,000 volts.
6	14 in. above roof of car.	The antenna conductor is insulated for 100,000 volts against power line overhead trolleys, etc.
7	13 ft. 10⅛ in.	1 in. O.D.x ½ in. I.D. Micarta tubing with dielectric strength of 300 volts per mil.—75,000 volts.
8	14 ft. 10 in.	To withstand 11,000 volts a.c. and 3,000 volts d.c.
9	14 ft. 8 in.	Micarta tubing Grade #52, 59/64 in. O.D. x ½ in. I.D. with #134 E finish.

The remainder of the report consists of a joint specification of the Communications Section and the Electrical Section (Mechanical Division) for intra-train telephone systems on rolling stock.

The report is signed by W. S. Heath (*chairman*), electrical assistant, Atchison, Topeka & Santa Fe; R. I. Fort, assistant research engineer, Illinois Central; W. H. Mims, electrical engineer, Central of Georgia; F. E. Gould, equipment inspector, New York Central; and D. F. Dunsmore, assistant electrical engineer, Chesapeake & Ohio.

Discussion

The report was presented by W. S. Heath, electrical assistant, Atchison, Topeka & Santa Fe. J. A. Bucy (B. & O.) spoke of trouble experienced with jumpers between cars and asked what other roads are doing to hold these jumpers in place and avoid friction. W. J. Madden, general foreman, Pennsylvania, said his railroad employs a rubber ring and hook on a 69-in. jumper which has proved highly satisfactory. Mr. Heath said that some roads use curtains to protect jumpers. He also said that sometimes the loops hang low enough to strike people passing between cars. Mr. Bucy said the cables are too long to be held with one ring and that when two are used, the plug is pulled from the receptacle. Mr. Heath said a bar and spring were used by the Santa Fe. This, Mr. Bucy said, is so complicated that in some cases the springs on the various cables get tangled. Mr. S. B. Pennell, assistant engineer, New York Central, spoke of complaints of ditry water falling on passengers. Mr. Bucy replied that his railroad has also had such complaints and that protective curtains were being tried. J. E. Gardner, electrical engineer, Chicago, Burlington & Quincy, said his railroad had been using curtains and that no complaints from passengers had been received. The matter was referred to the committee for further study.

A number of railroads have experienced trouble from the chafing of cables against the cars, and Mr. Bucy raised the question of whether or not the insulation thickness was sufficient. In the opinion of Mr. Heath, the cable manufacturers should be able to produce the answer. J. A. Andreucetti asked if such abrasion might be prevented by slipping a piece of hose over the cable. Mr. Bucy replied that the cables are in S form and that the point of abrasion varies. Mr. Gardner concluded the discussion by saying that wires in jumpers do fail and that there are just too many jumpers in the same place.

Car Electrical Equipment

Generator Drives

Concerning axle-generator drives, the report states that the Excel drive previously manufactured in Canada is now also being made in the United States.

Under-Car Power Plants

As a result of the report and discussion last year, it seems to be pretty well agreed among the four manufacturers of under-car Diesel equipment that such equipment will be designed so that they may be trainlined from car to car and operated in parallel; in fact, the question arises at this time as to how much automatic operation will be desired for paralleling such equipments. One manufacturer suggests that the automatic features be such that the entire train be paralleled at all times, with full automatic control of load distribution.

The other extreme on this phasing control is that of having the failed car taken care of by manually paralleling two or more units in the same train in much the same manner as a carlighting trainline is manually handled and has been handled for a number of years. This would involve no control circuits. However, such manually operated paralleling equipment should not involve the necessity of any adjustments on any of the equipments paralleled, i.e., it should involve only the matter of closing a switch and the equipments so connected will pull into phase and to frequency without difficulty.

This brings up the question of how many control circuits should be included in the trainline connectors carrying the 3-phase power between cars. At the present writing it would seem that until such standards are established on

the control circuits that it may be well to consider one 3-phase inter-car connector to carry the 220-volt, 3-phase circuits and an additional inter-car connector which may carry one or more pairs of wires to provide for the number of control circuits required.

While, as above pointed out, the manufacturers of this under-car equipment have definitely agreed that the equipment should be made so that it can be paralleled, the question still remains of adopting certain standards of alternator design to be followed by all manufacturers so that equipment from one manufacturer can be paralleled with equipment from another manufacturer, with the same ease and simplicity that the equipment of one manufacturer can be paralleled with a second equipment of the same manufacturer.

Experience thus far has definitely proven that this equipment can be built so that at no time is there a voltage variation of more than 5 volts which will permit of using standard lighting equipment. Two companies have very definitely committed themselves on this regulation and it is felt that this should be set as a standard.

Another very important feature that should be definitely standardized is the voltage of the battery used for cranking service on the Diesel engine. The committee recommends a 32-volt battery for this service. If and when such battery voltage is standardized, it will permit the manufacturers of the equipment to agree on production of a standard cranking motor and eliminate additional cost due to having more than one voltage to consider.

With reference to the equipment manufactured by the four manufacturers mentioned in last year's report, i.e., the Frigidaire, General Electric, Waukesha and Westinghouse: These companies report this year that the equipment is much the same as that set forth and quite extensively explained in last year's report, with the exception of the following:

The Frigidaire Division of General Motors Corporation has very definitely committed itself to parallel operation, which involves some modification and redesign of its present split-alternator type unit, substituting therefor a single voltage alternator.

The General Electric Company advises that it has adopted a 273 cu. in. engine (formerly 230 cu. in.), using a 30-kw. alternator (formerly 25-kw.). This company also reports improvements and modification of excitation control to permit of the close voltage regulation and a simplification of controls.

The Waukesha Motors Company has made no changes in its equipment.

The Westinghouse Electric Corporation has made some slight modification in the radiator cooling arrangement but otherwise the equipment remains unchanged.

Table I shows the performance of the Frigidaire unit on Southern Pacific Coach 2725, a further accumulation of data over that presented last year, and also shows performance on T. & P. Coach 1300, a further accumulation of data over last year's report.

The additional equipment that has been installed or on order since the report made last year includes:

Frigidaire—Proposed installation on 6 Santa Fe dome cars; an all-electric diner on the Pennsylvania (using 2 units).

General Electric—Completed 2-unit installation on the Illinois Central, all-electric diner which is reported operating satisfactorily. For the first four months fuel consumption has averaged 1.65 gallons and lubrication 0.141 gallons per hour of engine operation.

Waukesha—A proposed test unit for the Southern Pacific, which railroad already has had a Frigidaire unit in service for more than a year, and 12 units on suburban cars no building for the Rock Islnd.

Westinghouse—A unit on a Rock Island coach which has operated over 2,000 hours and is reported performing satisfactorily.

Installations on private, business and non-revenue cars are not listed in this report.

PERFORMANCE OF TEST FRIGIDAIRE UNDER-CAR DIESEL ON SOUTHERN PACIFIC COACH 2725

(On run between Los Angeles and New Orleans)

Period of Test (11/11/47 to 1/21/49)	14 months
Total mileage	226,540
Total hours Diesel operated	7,483
Total gallons Diesel fuel	11,828
Total gallons Diesel lubricating oil	122.9
Total cost Diesel fuel (@ $0.0714 gal.)	$844.61
Total cost lubricating oil (@ $0.594 gal.)	$73.00
Service labor	$872.44
Service material	$159.40
Fuel per 1000 miles (gallons)	52.2
Lubricating oil per 1000 miles (gallons)	0.55
Fuel per hour (gallons)	1.58
Lubricating oil per hour (gallons)	0.0164

	Cost per 1000 Miles	*Cost per Hour*
Fuel (@ $0.714 gal.)	$3.72	$0.1128
Lubricating oil (@ $0.594 gal.)	0.32	0.0097
Service labor	3.85	0.1166
Service material	0.70	0.0213
Total	$8.59	$0.2604

At 7,000 hours this unit was given a major overhaul at a cost of $853.49. However, the Southern Pacific advises that experience with the equipment would indicate that the engine could operate satisfactorily with a major overhaul at approximately 14,000 hours, or every 2 years, with a light overhaul at 7,000 hours, which light overhaul would consist of—

> Renewing valves, valve seats, liners, rings, three bearings (if necessary) and exchanging injectors. This would give a material cost of $160.00 and labor to apply of about $35.00.

The Southern Pacific also advise that the inspection of engine parts during the major overhaul indicated very little wear and a very clean engine throughout, which is attributed to taking engine air from inside the car.

	Per 1000 Miles	*Per Hour*
Overhaul cost	$3.77	$0.1141
Total cost including overhaul	12.36	0.3745

PERFORMANCE OF TEST FRIGIDAIRE UNDER-CAR DIESEL ON TEXAS PACIFIC COACH 1300

(Car used in general service, as power car and as demonstrator)

Period of test (8/7/47 to 1/3/49)	17 months
Total mileage	117,935
Total hours Diesel operated	4,792
Total gal. Diesel fuel	8,176
Total gal. Diesel lubricating oil	116.75
Total cost Diesel fuel (@ $0.09596 gal.)	$781.63
Total cost lubricating oil (@ $0.501 gal.)	$58.38
Service labor	$425.00
Service material	$9.50
Fuel per 1000 miles (gal.)*	78.8
Lubricating oil per 1000 miles (gal.)*	0.9902
Fuel per hour (gal.)	1.706
Lubricating oil per hour (gal.)	0.0243

	*Cost per 1000 Miles**	*Cost per Hour*
Fuel (@ $0.0956 gal.)	$7.53	$0.1620
Lubricating oil (@ $0.501 gal.)	0.50	0.0122
Service labor	3.77	0.0890

Service material	0.08	0.0020
Total	\$11.18	\$0.2652

* This does not reflect true cost, since car has been used extensively as power car and demonstrator.

Caboose Power Supply

Power supply for caboose radios is still in somewhat of an embryo stage, but the situation does show some signs of coalescing into a definite pattern.

While some few roads are continuing to use engine generator units (either gas or Diesel), the drive that seems to be increasing in popularity is the axle drive.

There are two types of axle drive—

1—The Dayton drive (with which everyone is familiar).

2—Preco drive, which consists of a friction cone riding the tread of the car wheel, such as has been used in driving ventilator fans in refrigerator cars for several years. The latest modification of this drive uses a grooving pattern in the tire and utilizes a greater pressure on the cone.

With these drives, there are two general types of generators used (both types using batteries)—

1—The conventional Safety generator.

2—The Leece-Neville generator that has become so popular in the automotive industry. This consists of an alternator and rectifier with built-in regulator, with output of either 6 or 14 volts, d.c.

Considerable interest has been evidenced in the air-motor generator mentioned in last year's report, and another manufacturer of pneumatic tools has offered such an equipment for test. The Rock Island had a unit consisting of an air motor driving a Leece-Neville alternator rectifier unit with 6-volt d.c. output. This ran on a terminal way car for about 14 months. The generator had an output of 20 amp. and was coupled to a 179 amp.-hr. battery (1225 gravity). The unit cuts out at an air pressure of 62 lb. per sq. in. gage, and cuts in at 65 lb. per sq. in. gage. When the radio is in operation it draws 10 amp. constantly. In transmitting 20 amp. are required. This is used with a Galvin (Motorola) radio of the dispatcher's type (same as used in taxicabs). It has been found that an average 13-amp. output is sufficient to keep the battery charged and the radio operating. So that no interference with braking operation will be possible, the air motor is operated from a reservoir through a 3/16 in. orifice, and the reservoir is connected to the trainline through a 1/8 in. orifice.

Electric Cooking

The committee has nothing to report on electric cooking not already covered in last year's report, except that the I. C. R. R. has now placed in service a full electric diner which is reported to be operating satisfactorily. Information covering load data and service record is as follows:

ALL ELECTRIC ILLINOIS CENTRAL DINING CAR NO. 4111

This dining car seats 36 and has been in revenue service about four months. The connected loads are as follows:

	Kw.
Refrigeration:	
1 at 3/4 hp. (Ice cube maker)	.8
5 at 1/4 hp.	1.5
3 at 5/8 hp.	.6
Ventilation	.2
Air conditioning	10.0
Lighting	2.1
Ranges	14.
Fry kettle	2.6
Backshelf broiler	5.3
Coffee urn	4.
Hot food table	1.3
Water heater	3.
Charcoal type broiler	4.
Plate warmer	1.5
Cup warmer	1.5
Bouillon cup warmer	1.5
Dish washer	1.1
Garbage disposal	.4
Food mixer	.2
Fruit juicer	.1
Glass washer	.1
Water circulating pump	.4
M.-G. set	10.0
Radiator fans	1.5
Total	67.7

The main air conditioning fan, all control, and a few lights are on the battery and therefore are included in the 10 kw. for the m.-g. set.

The following two tables give hourly energy and demand for two successive trips on a three-day round trip. These data are typical of the load fluctuations which have been found to be rather consistent:

ALL ELECTRIC ILLINOIS CENTRAL DINING CAR NO. 4111

First Trip

	First Day		Second Day		Third Day	
Time	Kwh.	Peak kw.	Kwh.	Peak kw.	Kwh.	Peak kw.
12—1 a.m.			8	8	8	8
1—2			7	7	8	8
2—3			7	7	8	8
3—4			7	7	9	16
4—5			17	20	16	29
5—6			36	44	26	36
6—7	3	10	34	39	30	39
7—8	30	38	35	41	32	38
8—9	28	36L	33	41	30	38
9—10	26	34	32	38	29	36
10—11	25	31	31	39	30	38
11—12	29	36	28	33	30	37
12—1 p.m.	29	37	28	31	30	37
1—2	28	36	27	30	29	36
2—3	31	40	24	29A	26	35
3—4	32	38	26	29	26	35
4—5	31	36	29	35L	26	32
5—6	29	35	31	38	25	34
6—7	29	35	32	38	25	35
7—8	24	36	34	43	24	34
8—9	19	24	25	34	25	23
9—10	12	22	21	21	22	15
10—11	7	8	9	10	8	8A
11—12 a.m.	8	8	8	9	7	7
	420		569		519	

		First Day	Second Day	Third Day
Approx.	Temp.	75	85	80
Served—	Breakfast	25	79	140
	Lunch	54	36	81
	Dinner	81	81	115

Second Trip

	First Day		Second Day		Third Day	
Time	Kwh.	Peak kw.	Kwh.	Peak kw.	Kwh.	Peak kw.
12—1 a.m.	7	8	6	6	8	9
1—2	4	7	7	6	7	7
2—3			6	6	7	7
3—4			6	6	7	7
4—5			15	32	19	32
5—6	4	11	31	38	28	38
6—7	13	31	31	42	26	37
7—8	29	38	34	46	26	38
8—9	29	37L	33	44	27	37

Second Trip (Continued)

Time	First Day Kwh.	First Day Peak kw.	Second Day Kwh.	Second Day Peak kw.	Third Day Kwh.	Third Day Peak kw.
9—10 a.m.	27	35	28	36	27	39
10—11	27	37	34	45	25	38
11—12	29	42	37	43	28	39
12—1 p.m.	32	44	31	43	31	39
1—2	31	41	24	32	27	38
2—3	28	36	21	31A	16	26
3—4	25	37	28	34	17	33
4—5	27	39	28	39L	30	43
5—6	30	43	32	42	27	40
6—7	30	40	28	36	26	38
7—8	30	41	24	36	18	32
8—9	29	38	19	26	13	18
9—10	15	24	9	12	9	9
10—11	8	22	7	7	7	7A
11—12 a.m.	6	6	8	9	7	7
	450		527		463	
Approx. Temp.	75		85		75	
Served—Breakfast	38		125		107	
Lunch	109		58		63	
Dinner	137		42		90	

Fuel for Trip .... 201 gallons

L—Leave.

A—Arrive.

Electric Diner Equipment

The committee has investigated the power requirements for the Radar Range equipment and received the following information from Owen Webber, Inc.

The equipment operates on 220 volt a.c. single phase and the following equipment is suggested by the manufacturer:

Equipment	*Watts*
Coffee urn, electric	3,000
Mechanical refrigeration	4,000
Dishwasher	600
Toaster, electric	1,500
Electronic ranges, 2 and 5.25 kw.	10,500
Searer, 1 at 6 kw.	6,000
Trunion kettles, 2 at 1 kw.	2,000
Induction heaters, 2 at 2.6 kw.	5,200
Egg boilers	500
Total	33,300

Each electronic oven in stand-by condition, i.e., ready for service but not in actual operation, requires only 600 watts with 5.25 kw. in full operation.

In view of the fact that the cooking utensils associated with induction heaters cannot be removed until the current is shut off, this equipment operates with a timing device and therefore the actual operating load during a large part of the meal service period is reduced to a minimum.

The Pennsylvania now has a part of this equipment on test and further information will be available on this subject for next year's report.

The report is signed by S. B. Pennell (*chairman*), assistant engineer, New York Central; L. C. Bowes, electrical engineer, Chicago, Rock Island & Pacific; J. A. Bucy, electrical supervisor, Baltimore & Ohio; V. F. Dowden, engineer car electrical equipment, New York, New Haven & Hartford; J. E. Gardner, electrical engineer, Chicago, Burlington & Quincy; K. H. Gordon, assistant electrical engineer, Pennsylvania; R. A. Harrington, engineer train lighting, Chicago, Milwaukee, St. Paul & Pacific; W. L. Monk, chief inspector of train lighting and air conditioning, Canadian National; J. W. Sharpley, train lighting engineer, Canadian Pacific; L. J. Verbarg, assistant to chief mechanical officer, Missouri-Pacific; and G. W. Wall, electrical foreman, Delaware, Lackawanna & Western.

Discussion

The report was presented by S. B. Pennell, assistant engineer, New York Central; L. C. Bowes, Electrical engineer, Chicago, Rock Island & Pacific; and J. A. Bucy, electrical supervisor, Baltimore & Ohio.

The question of load protection, particularly on cars with electro-mechanical air conditioning was raised by R. H. Turner, electrical engineer, Wabash. He said that loads of 600 amp. at 32 volts make trainlining difficult and that it would be desirable to find a means of reducing the load automatically when cars are trainlined. Under present conditions, he said, a car failure should be allowed to be a complete failure. He asked to have the matter studied by the committee. J. A. Bucy (B. & O.) concurred with Mr. Turner, saying that when a battery is discharged, not only is there an air conditioning failure, but with electric heat control, the heat may come on.

R. W. Tonning, electrical engineer, Atlantic Coast Line, called attention to the fact that it is often necessary to have cars with 32, 64 and 110-volt systems with Edison and lead batteries in the same train, making trainlining impossible. W. S. H. Hamilton (N. Y. C.) said that with a low-battery on one car, the inrush of current which occurs when cars are trainlined will often blow a fuse. His railroad, he said, is now experimenting with thermal-trip breakers. S. B. Pennell (N. Y. C.) explained that a failed car on the New York Central carries only lighting load and the compressors do not work. Cars with 64-volt systems, he said, are so marked. Mr. Tonning suggested that the committee should determine how much power must be put over a trainline on trains using under-car power plants. L. C. Bowes (C., R. I. & P.) said that with under-car, 220-volt plants the current is greatly reduced. A suitable design of car connector, he said, must be developed. It is the opinion of the committee that 50 kw. would be the maximum which need be carried.

A. E. Voigt (A., T. & S. F.) said that the Santa Fe has a 2-kw. generator driven by a flat endless belt with stationary generator and belt tension, provided by a spring-adjusted idler which has obtained 10 months' service on one belt.

In presenting assignments 4 and 5 of the report, Mr. Bucy gave all credit for the work done to R. I. Fort, assistant research engineer, Illinois Central. He told of having had dinner on a diner equipped with under-car power plants, and said that although the car was stationary and the engines running, the vibration was very slight.

A discussion of the report's recommendation for link fuses showed that the lengths chosen would permit the use of such fuses in all applications. The desirability of silver plating contacts was discussed and the desirability of the practice agreed upon. Specifications for silver plating will be considered in a future report.

Car Air Conditioning Equipment

New Developments

The Anemostat Corporation of America has developed the Straight-Lines Asperating Anemostat Air Diffuser, similar in function and performance to the conventional Anemostat Air Diguser.

The design and fabrication of this unit is such that it can be used in individual panels of varied lengths per unit or assembled into continuous extended lengths. Various combi-

nations can be obtained, and in combination with continuous or individual light strips. It may be mounted back to back as one straight line diffuser, or with a continuous light in the center which is allowed for by spreading the outlet to accommodate any given light fixture.

Air distribution is readily equalized throughout the length of diffuser by means of adjustable volume shutters accessible from the face of the unit.

The Equipment Research Corporation offers the Baffle Air System of Air Distribution, consisting of perforated panels forming part of car ceiling, and a system of baffles and perforated plates in the air duct to control and distribute the cooled and warmed air from the blower fan to the perforated ceiling panels for the length of car.

The Pullman-Standard Car Manufacturing Company has submitted a description and print of a drawing showing a Proposed Ventilation System for Kitchen, consisting of a balanced supply and exhaust air volume control, whereby the air supply and exhaust fans are under the control of a single control switch, position selected according to ventilation requirements. The drawings covering the proposed kitchen ventilation system are marked "Patent Applied For," but details of such claims are not mentioned. Basically, the report states, the principle of balanced ventilation and arrangement of air supply described above is the same as developed by the New York Central and incorporated in construction of the new post-war kitchen car equipment.

Electronic Filters

The performance record of twelve sleeping cars equipped with American Air Filter Electronic Air Filter has been studied with the following results:

Over-voltage has been pretty well corrected, except in isolated cases where the operation has been in the top ranges. In these isolated cases, flashovers occur under certain weather conditions, causing objectionable noises resembling the continuous firing of a toy cap pistol. Excessive rectifier tube burnouts have been caused by the high operating voltages. There appears to be considerable room for improvement in the discharge resistor, since there is no practical way to detect its failure.

The performance record of forty-six C. & O. passenger train cars equipped with American Air Filter Companys Rotoclone and Electro Airmat has been studied with the following results:

It has been determined that improper sealing around the filter frames has been a primary factor in allowing dirt flashes to occur around the air outlet grilles. Ten cars have been properly sealed, with excellent results in all cases. It has also been found that the initial setting of the primary voltage is critical, so as to produce a secondary voltage between 12,000 and 12,800 volts. The life of the media is dependent upon many variables that are determined by the type of service in which the car is operating. In most cases on the C. & O. the life extends over a period of thirty days. On the twelve sleeping cars tested, fifteen days appear to be the life of the media. The C. & O. has abandoned the use of paper media in favor of fiber-glass on all installations. The cost of labor for maintenance of the Electro-Air-Mat is considerably greater than for mechanical type filters.

Temperature and Humidity Control

In the 1948 proceedings, the salient features of the three types of thermostatic temperature control (Electronic Moduflow, Cycle Modulation and F/S Modulated Control) were described in detail, and the advantages of each type were outlined. The following modifications to these systems are reported as new installations:

Electronic Control Systems have been installed or are being installed by several railroads, utilizing a method of circulating fluid for waste heat recovery for heating purposes, and, from the available information, these systems are performing satisfactorily in road service.

In this system, the engine coolant is circulated through a primary loop beneath the floor for supplying heat to the overhead radiator, side wall floor radiators, and wash water heater. The coolant in the primary loop is also heated by an exhaust gas heat exchanger and a steam and electric heat exchanger. Thermal means is provided to bypass the coolant through the engine radiator if the demand for heat in the car does not exist; also during these periods an automatic damper permits the exhaust gases to pass to atmosphere. Flow type fittings are employed in the primary loop to obtain the proper thermal balance of the system. Each side wall loop has a motor-driven pump for circulating the coolant. An expansion tank is provided to insure satisfactory operation.

The car temperature control is effected by means of resistance type thermostats, electronic relays, and motorized valves.

A system of electronic control is also being installed by one of the railroads in which resistance type thermostats are used to control the heating of the car with conventional low pressure steam radiation surface. While this system will not provide the same degree of refinement that the system employing a circulating heating fluid affords, nevertheless its simplicity makes it attractive.

Improvement in Cycle Modulation include a system of waste heat recovery consisting of a loop through which is circulated, by means of an electric-driven pump, a coolant liquid which is passed through a wash water heat exchanger, then to the exhaust gas heat exchanger, thence to a steam and electric heat exchanger which is used when necessary to provide additional heat, then through an expansion tank to an overhead radiator, thence to the side wall floor radiation and back again to the pump to complete the cycle. A damper allows the exhaust gases to pass to atmosphere when no heat is required in the car. If the coolant temperature is above 190 deg. F., sufficient water is bypassed to the engine radiator to maintain safe engine temperatures.

A thermal valve causes the engine jacket coolant to be recirculated within the engine if the coolant temperature is below 140 deg. F. The control of temperature is governed by a Rador thermostat located in the car body, operating solenoid valves so that when the heat is required in the car the coolant is deflected through the heat exchanger, and when no further heating is required, the coolant is returned to the pump, by-passing the heat exchangers.

The Fulton Sylphon improvements include a non-electric type of control whereby the side wall floor radiation is divided into several sections, each provided with a direct acting modulating valve actuated by a thermal element responsive to car temperature in the zone of its location. This system has the advantage that it eliminates the conventional type mercury tube or bi-metallic type thermostats with their associated wiring and relays.

The Trane Company has developed a new system of passenger car air-conditioning consisting of two divisions, namely, a moisture controller and a sensible cooler. In the moisture-controller section, a motor-driven centrifugal fan draws fresh filtered air from outside the car and passes it first over an extended surface heat exchanger of the air-to-air type, and then through the main evaporator where its temperature is reduced to approximately 40 deg. to 45 deg. F., and then it again passes through the air-to-air heat exchanger where it is reheated. Next, this conditioned air is mixed with the filtered recirculated air from the car and passed through the sensible cooler, heated and discharged by the main blower to the body of the car.

The master selector switch which controls the operation of the two main divisions has four positions, namely, full conditioning, precool, ventilate, and off. In the full condition-

ing position, the outside air is cooled and tempered; in the precool position, only the sensible cooler is operated to rapidly reduce the temperature of the air of the car; in the ventilating position, the fresh air fan is operated without the moisture controller; and of course, in the Off position, all parts of the system are idle.

The temperature control includes a duct thermostat at the down stream side of the moisture controller and serves to maintain the proper dew point, and a room thermostat functions to supply heat or cooling in the sensible cooling unit to maintain proper car temperatures.

Experiments are being conducted by several railroads with Customair systems, but no service data are available at present.

Fire-Resistant Filters

There have been no further developments since the 1948 report, and, as outlined in that report, the real solution lies in more frequent cleaning, to prevent fires. If automatic protection is desired, the use of a photo-electric cell is indicated, to interrupt air circulation in the event of fire. Manual interruption of this circuit is possible, but the probabilities are that considerable smoke would be accumulated in the car, causing hysteria and possibly personal injury and property damage before manual interruption could be accomplished.

Report of Sub-Committee No. 5

Assignment.—Investigate mechanical refrigeration for purposes other than air-conditioning.

Action Recommended.—It is recommended that this report be accepted as progress, and that the assignment be continued.

The following specifications have been drawn up to standardize a phase of refrigeration that is still in its infancy, to facilitate repairs by railroads and the manufacture by the suppliers.

Mechanical Refrigeration Specifications

The report includes detailed specifications covering electro-mechanical refrigeration apparatus for a combined unit for food storage and drinking water purposes on railroad passenger equipment cars. These are not included in this abstract.

Hermetically-Sealed Refrigerating Units

Hermetically sealed air conditioning units are still in the development state. There was one installation made on Rock Island car 209, as follows:

This equipment consists of two hermetically sealed motor-driven, 220-volt, 3-phase, 60-cycle compressor units, operating on two separate and individual evaporators, the evaporators so arranged, however, that by cutting out one compressor there is no stratification as the coils from each evaporator are so interspersed that there is no isolation vertically or horizontally.

In the overhead duct is placed a dual thermostat set at 85 deg. and 90 deg. There is also placed a 70 deg. thermostat for the overhead steam, and in the fresh air intake is placed a 60 deg. thermostat. There is also the body thermostat in the car, as well as the floor thermostat, which have been common to the heating of the car before the Westinghouse installation was made.

The body thermostat is interlocked with the duct thermostats and works on the set-down resistor on the dual thermostat. The floor thermostat is placed in the hallway at the air conditioning end and has a 76-deg. tube with a set-down to 68 deg.

The primary overhead heat is electric, consisting of space heaters on 3 phases of the 220-volt circuit and they are controlled with saturable core reactors, one in each of the 3 phases. The primary winding on the reactors is in series with the space heaters. The secondary winding on the reactors is d.c. and the 3 secondaries, one of each phase, are connected in series through a variable resistance to the 32-volt d.c. circuit. When the maximum resistance on this variable resistor is cut in, the current in the reactors is reduced to nearly zero and the electric heat is almost entirely off. With the resistance cut down or reduced to a minimum, there is a flow of 12 amp. in the d.c. secondary reactor winding, which permits a full kw. electric load on the heating elements. The dual thermostat in the overhead duct controls a reversible motor which operates the variable resistor, which resistor is in the form of a circular rheostat. As the call for less heat is made, the variable motor increases the resistance, thus decreasing the electric heat, and when the motor is reversed because of the call for more heat, the resistance is decreased.

When the outside temperature rises to 60 deg., the No. 1 compressor cuts in and the electric heat is increased to balance the car temperature. When the outside temperature continues to rise, the electric heat is reduced to maintain the car temperature with the No. 1 compressor continuing to run. As the temperature continues to rise above 60 deg., the inside electric heat is continued to be reduced until it is practically cut out.

When the temperature can no longer be maintained by the No. 1 compressor, the No. 2 compressor cuts in on a 2-deg. rise in temperature and will cycle on and off to maintain body temperature at the proper point. This compressor is brought in by a separate inside cooling thermostat, which is located alongside of the body thermostat.

If, for any reason, the electric overhead fails, or is not sufficient to supply the requirements, a 70-deg. thermostat, located alongside the body thermostat, will bring in the overhead steam heat.

Locations for Thermostats

Inasmuch as thermostat locations are dependent on so many variables, such as car construction, interior arrangement, and type of systems, it is practically impossible to designate standard locations of thermostats. However, to facilitate the maintenance and operation, particularly in off-line operation, it is recommended that a diagram be placed in the electric locker, under glass, or otherwise protected against theft, giving the exact location of thermostats and their respective valves.

The report is signed by K. T. Benninger, (*chairman*), general electrical supervisor, Chicago & Eastern Illinois; C. R. Bland, special engineer air conditioning and electrical equipment, Chesapeake & Ohio; J. L. Christen, yard department, The Pullman Company; H. J. Dawson, traveling electrical supervisor, Illinois Central; G. E. Hauss, electrical supervisor, Baltimore & Ohio; D. C. Houston, electrical engineer, St. Louis-San Francisco; W. J. Madden, general foreman, Pennsylvania; R. W. Tonning, electrical engineer, Atlantic Coast Line; A. E. Voigt, car lighting and air conditioning engineer, Atchison, Topeka & Santa Fe; and G. T. Wilson, assistant engineer car equipment, New York Central.

Discussion

The report was presented by K. T. Benninger, general electrical supervisor, Chicago & Eastern Illinois. New information was offered by A. E. Voigt (A., T. & S. F.). To meet the requirements of the California Commission, the Sante Fe has used aluminum shields on kitchen ranges and smoke stacks in dining car kitchens. Grease traps are placed under kitchen hoods. Ventilation is arranged to pull in

2,000 cu. ft. of air per min., exhausting slightly less than that through exhaust outlets. In spite of the arrangement, it is not possible to maintain positive pressure in the car with all wind directions. Temperatures in the kitchen are lower than obtained previously and do not exceed 140 deg. at any point in the kitchen. In response to a question, Mr. Voigt said that it has been necessary to take air in from one side only, and that it would be better to take it in from both sides. It had, he said, been found necessary to use baffles and scoops to get the required amount of air at high train speeds.

G. S. Glaiber, general supervisor, electrical equipment, New York Central, said that on his railroad it had been found necessary to exhaust more air from the kitchen than is put in to prevent kitchen air from backing up into the dining compartment. The incoming air, he said, is filtered and the crews are satisfied. Mr. Voigt said that Santa Fe cars are also arranged so that some air flows from the dining section to the kitchen.

In response to a question, Mr. Voigt explained that while radiant heat was not affected by air motion, the use of shields transferred the radiant heat to the shields from which it was removed by the passing air.

F. O. Marshall (Pullman Company) called attention to a study of emissivity made recently by the Aluminum Company of America, which he said should be useful to those considering the removal of heat from dining car kitchens.

A general discussion emphasized the desirability of the Electrical Section working with the A. A. R. Car Construction Committee, The Association of Dining Car Superintendents and the U. S. Public Health Commission.

R. F. Dougherty, general electrical and air conditioning inspector, Union Pacific, asked for information concerning the effect of filter maintenance of other car equipment. C. R. Bland (C. & O.) replied that the cost of electrostatic filter maintenance was about four times as much as that for mechanical filters, but that conditions in the car were greatly improved by the use of the electrostatic filters. He added that it is also the practice of the Chesapeake & Ohio to use Rotoclone air cleaners ahead of the filters. He also said that his railroad at first used paper filters, but that they were afraid of the fire hazard involved and later changed to Fiberglas. It is necessary, he said, to keep the filter voltage below 12,800 volts to avoid noise and to obtain satisfactory life of rectifier tubes.

Replying to a question on costs, Mr. Bland said that the present price of filter paper is $5.15 for 225 ft., while a 125-ft. roll of Fiberglas costs $7.15. Originally the paper filters were changed every 15 days, but it was found that the time between changes of Fiberglas filters could be extended to 30 days making the cost of the two about the same. He also said that the performance of the filters was just as good during the second 15 days as it was during the first.

Mr. Voigt wanted to know if dirt retards the flow of air through a filter. Mr. Bland replied that there was no appreciable retardation in 30 days and said that longer periods would be tried.

The subject of mechanical refrigeration was introduced by Mr. Glaiber. He said that adequate ventilation for such refrigeration depends to a large extent on car design and added that conversion jobs present the greatest difficulty. W. J. Madden, general foreman, Pennsylvania, said that his experience substantiated Mr. Glaiber on the importance of ventilation. Mr. Glaiber added that the New York Central now has 52 cars equipped with mechanical refrigeration, and that, in most cases, it has worked out satisfactorily.

A question concerning the use of carbo-freezers using dry ice with Freon coils was raised by Mr. Voigt and Mr. Bucy said that this too is a matter of adequate ventilation.

Electric Rolling Stock

Developments in Motive Power

The report includes brief descriptions of recently developed Diesel-electric locomotives and train heating boilers. These include the Electro-Motive F7 and FP7 locomotives, successors to the F3 series and the new E8, high-speed passenger locomotive which is successor to the E7. They also include the Fairbanks Morse & Company Consolidation Line of passenger and freight locomotives and the General Electric, 65-ton Diesel-electric switcher.

New steam generators described, include the Superheater Company, Elesco Forced Recirculation steam generator and the Intensi-Fired steam generator produced by The Vapor Heating Corporation.

Voltage Control of Locomotive Batteries

Battery voltage control was discussed in last year's report in which it was brought out that there is a need for better means of automatically controlling the charging of storage batteries in Diesel locomotive service, primarily to prevent overcharging, causing increased battery temperature, resulting in shortening the battery life.

Some experimenting has been done with batteries in car lighting service in which a temperature relay was located in the battery compartment so arranged as to measure as nearly as practicable the temperature of the battery itself. The function of the relay is to reduce the voltage of the generator with a corresponding reduction in charging rate when the battery reaches a dangerous temperature.

While satisfactory results have been reported, their use has never gone beyond the experimental stage in the development of the equipment, nor has any application been made to batteries in Diesel locomotive service.

The storage battery manufacturers who have been following this development feel that unless the railroads indicate there is a real need for an improved control in battery charging in Diesel locomotive service, they will not be justified in further development of control equipment using this principle.

As there have been improvements in the control equipment now used for regulation of the charging of the storage batteries, the committee feels that unless there is more interest on the part of the railroads for developing something better, that further investigation of this subject be dropped.

Diesel-Electric Locomotive Controls

It is desirable to have the engineman's control devices, such as handles, markings and warning indications, similar and similarly located on all makes of Diesel-electrics.

Two views have been expressed with respect to standard warning indications, supplemented by a buzzer:

(a) A system of colored lights, each color to indicate the operation of a certain relay or device.

(b) A warning device indicator, consisting of vertical row of white lamps each in a separate compartment, all in one frame. A plastic cover in front of each lamp, with the name of the device which has operated, thus: Ground Relay, Hot Engine, etc. Such an indicator has been used satisfactorily on electric locomotives for years.

It is recommended that operating coils of relays and trouble detection devices be attached to the negative side of control circuits, to simplify such circuits and expedite the detection of trouble in such circuits.

With a view to ascertaining the opinion of various railroads a questionnaire will be sent out on items concerning this assignment.

Slipping Wheels

As stated in the 1947 proceedings, several devices have been used on motor-driven rolling stock, with reasonable

satisfaction; but complete protection has not yet been provided for Diesel-electric locomotives.

Under certain operating conditions, satisfactory detection of slipping has been reported with a differential current-sensitive type of relay, connected in the motor circuits.

Any device installed for wheel slip protection on Diesel-electric locomotives should, if possible, provide wheel slide protection also. Several railroads are actively interested in the further development of an axle commutator device, already available, to detect both slipping and sliding, regardless whether or not power is applied to the traction motors.

Further progress towards a solution of these problems would be expedited by tests, using apparatus which will detect and record for study the causes, extent, and if possible the results of slipping and sliding. There would be great advantage in having like protection on as many types of Diesel-electric locomotives as possible.

Lead and Terminal Marking

A section of the report on lead and terminal marking of apparatus furnished for locomotive and car equipment states that they should follow the American Standard Terminal Markings for Electrical Apparatus as approved by the American Standards Association, C.6.1-1944, and any revisions thereof except as provided by the Electrical Section Report.

1. Lead and terminal marking of a.c. and d.c. traction motors shall follow A. A. R. Standards as given in this section, under "Lead Markings of Traction Motors."
2. Lead and terminal marking of starting windings shall be designated, K_1, K_2, etc.
3. Standards for terminal marking of Regulating Exciters (Amplidyne Type), shall be as shown in the Electrical Section Report.
4. Symbols for induction alternators, eddy current brakes, or clutches and track brakes, which symbols do not appear in A.S.A. Standards, are also given in the report.

Wire and Cable for Locomotives

This subject was originally brought up by one of the members who was finding it necessary to replace cable on some Diesel-electric locomotives after relatively short life. Inasmuch as the type of cable being removed was what had been, and in fact still is, considered a standard for this service, the matter is of considerable interest.

Last year the committee reported on the results of a questionnaire based on service experience of some railroads and recommendations of some locomotive builders.

While the progress this year is not great, there seems to be a marked increase in the interest on the part of the manufacturers. This is very desirable, since the number of Diesel locomotives in use is increasing daily. It should be noted, however, that improved insulations, if apparently satisfactory in laboratory tests, must be proved out in service. Such full scale tests must be ventured whenever possible to determine the best insulations before wholesale renewals in the normal course of maintenance become due.

Meanwhile, braid-covered synthetics of the flamenol type, and synthetic rubbers, have been reported favorably.

The report is signed by R. I. Fort (chairman), assistant research engineer, Illinois Central; L. S. Billau, electrical engineer, Baltimore & Ohio; E. J. Feasey, general supervisor of Diesel Equipment, Canadian National; W. S. H. Hamilton, engineer, Electrical Equipment, New York Central; W. L. Huebner, supervisor Diesel engines, Atchison, Topeka & Santa Fe; H. C. Paige, assistant mechanical engineer, New York, New Haven & Hartford; P. J. Shannon, general Diesel supervisor, Atlantic Coast Line; J. Stair, Jr., Electrical Engineer, Pennsylvania; C. F. Steinbrink, general electrical foreman, Chicago, Rock Island & Pacific; H. C. Taylor, Diesel superintendent, Southern; P. H. Verd, superintendent of motive power & equipment, Elgin, Joliet & Eastern; and L. Wylie, electrical engineer, Chicago, Milwaukee, St. Paul & Pacific.

The following associate members also signed the report: H. E. Dralle, Westinghouse Electric Corporation; P. A. McGee, Electro-Motive Division, General Motors Corporation; T. F. Perkinson, General Electric Company; K. B. Rowell, American Locomotive Company; D. R. Staples, Baldwin Locomotive Works; J. K. Stotz, Fairbanks, Morse & Company; H. H. Lanning (*chairman*, Locomotive Construction Committee), mechanical engineer, Atchison, Topeka & Santa Fe; and A. G. Hoppe (*vice-chairman*, Diesel Locomotive Section of Locomotive Construction Committee), general superintendent locomotive department, Chicago, Milwaukee, St. Paul & Pacific.

Discussion

The report was presented before a joint session of the Locomotive Maintenance Officers Association and the Electrical Section, Mechanical Division, A. A. R., by W. S. H. Hamilton, engineer, electrical equipment, New York Central.

In response to a question on the value of thermostats for controlling battery charging rates, C. B. McCormick, Electric Storage Battery Company, said that his company had run tests. These tests, he said, showed that their use had cut maintenance and other costs about one-third. The thermostats were adjusted to reduce the charging voltage from 38 to 36½ volts when the battery temperature reached 80 deg. F. The thermostats, he said, were located in the battery box just above the battery.

During a discussion of wheel-slip on Diesel-electric locomotives, J. W. Teker, Motor Division, General Electric Company, said that some traction motors had failed due to overspeed and that it was usually the No. 1 axle with icy or wet rails. J. A. Bucy (B. & O.) said that on his road they had had several such failures on the rear motors of trucks when there were no icy or wet rails. He added that he does not believe controls can be confined to front wheels on front trucks alone. He also said that electrical connectors are not designed to keep out brake shoe dust, etc., and that many failures are caused by short circuits in connectors. M. H. Harrington, General Electric Company, asked if the railroads would be willing to pay for a wheel-slip device which would eliminate wheel slipping. Mr. Bucy offered the opinion that the railroads would have to avoid failures, and that cost was a secondary item.

A. K. Galloway, general superintendent, Baltimore & Ohio, said he could not see how a Decelostat would show stuck wheels and added that some way must be found to stop failures of armature bearings. He approved of gadgets to detect difficulties, but said the railroads should not attempt to make them standard until they are thoroughly proven. He said his railroad had used hot box alarms, and that they had had some false alarms, but that correct indications justify their use. He also said it may be that standards of track maintenance may have to be improved. Continuing with the subject of motor bearing failures, he said, it was not lubrication that caused bearing failures, but the bearings themselves, and added that while the number had been reduced, there still were bearing failures.

C. H. Griffith, chief electrical engineer, Missouri, Kansas & Texas, said he did not expect the manufacturers to produce a bearing that would never fail and said there was need of an indication which would positively show wheel slide. C. H. Peterson, shop engineer, Chicago & North Western, said his road was now experimenting with a device which operates on traction motor voltage. Mr. Galloway said he did not wish to be misunderstood, that he wanted a stuck wheel device, but that he also wants better armature bearings. P. C. Dunn, superintendent locomotive maintenance, Boston & Maine, said an armature bearing will

sometimes fail on a dead locomotive while being hauled and offered the opinion that a good stink bomb will serve better than an electrical gadget.

E. P. Gangewere, assistant general manager, Reading, said he thought that electrical equipment on Diesel locomotives should be simplified.

It was also said that when wheels locked, it was usually after the locomotive stopped and that the cost of putting a traveling laboratory on a locomotive was very high. In response to this, Mr. Peterson said the device he referred to is simple, and will indicate either a stuck or slipping wheel.

Mr. Griffith asked if any road is using stink bombs on axle support bearings and cited a case of an axle failure caused by an axle support bearing. Mr. Hamilton replied that the New York Central is experimenting with stink bombs on axle support bearings.

Mr. Bucy said the question is not how to fix it, but how to prevent it, and added that he agreed with the statement that manufacturers have a real responsibility. Mr. Teker said he always goes back from these conventions impressed with the shortcomings of the manufacturers. He offered the suggestion that at the time of wheel change, the motors be run and listened to. He said that bearings rarely fail suddenly, and it is possible to run the motors and detect the little clicking that indicates progressive bearing failure.

Electrical Section Engineering Division

The Electrical Section, Engineering Division, A. A. R., held morning and afternoon meetings at the Hotel LaSalle, Chicago, on Thursday, September 22. The meeting was opened by Chairman S. R. Negley, electrical engineer, Reading, who introduced L. S. Werthmuller, Chairman, Signal Section, A. A. R., and signal engineer, Missouri Pacific. He said that with the broadening of electrical applications, there is constantly more to be done by the Section. It provides itself with a committee of experts which could not be had on any one railroad. Frequently, he said, it is necessary to review old studies in view of changing conditions, and stated a number of examples. He called attention to the forthcoming opening of the A. A. R. research laboratory, saying that the Section should not overlook any opportunity of referring important research problems to G. M. Magee, who will be responsible for work done in the laboratory.

Electrical Section—Engineering Division Association of American Railroads

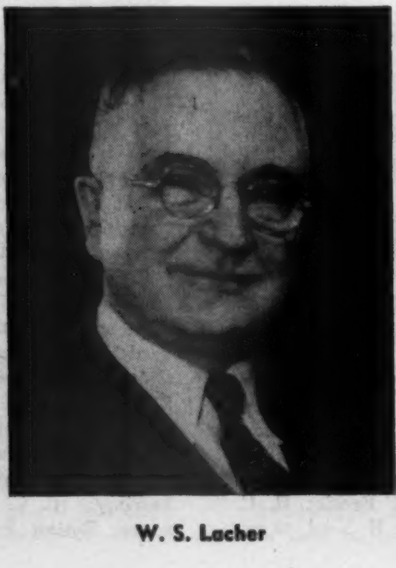
Officers

S. R. Negley, *Chairman*, electrical engineer, Reading, Philadelphia, Pa.

H. F. Finnemore, *Vice Chairman*, chief electrical engineer, Canadian National, Montreal, Canada

W. S. Lacher, *Secretary*, Electrical Section, Engineering Division A. A. R., Chicago


H. F. Finnemore


W. S. Lacher


S. R. Negley

The Southern's Diesel shop at Citico, Tenn.

Chairman Negley outlined the contents of the several reports to be presented, and asked that each committee have at least one meeting during the coming year, and not leave too much to correspondence. Referring to Mr. Werthmuller's talk, he said that the 40-hr. week has now given increased importance to applications of equipment which were previously borderline cases. He also announced that W. S. Lacher, Secretary of the Section, would retire at the close of the session.

H. F. Brown, electrical engineer, New York, New Haven & Hartford, rose at this announcement and suggested that a committee of resolutions should be appointed to express the sentiments of the Section to Mr. Lacher. He expressed appreciation of Mr. Lacher's long and efficient service. In response, Mr. Lacher said he had thoroughly enjoyed the position and the opportunity it afforded him of making friends. He also suggested that the Section's appreciation should be tempered with the thought, as he put it, "I get paid for this work and you fellows all do it for nothing"

Power Supply

A complete new shop for heavy and running repair of Diesel locomotives was completed and placed in service late in 1948 by the Southern at Chattanooga, Tenn. The facilities are designed for full repair work on Diesel freight locomotives operating between Chattanooga and St. Louis, Cincinnati, New Orleans and intermediate points.

The main portion of the building contains five repair tracks, each of sufficient length for a three-unit freight locomotive. An extension at the end of the building, approximately 110 ft. by 108 ft. provides space for a parts reconditioning room, filter cleaning room, tool room and office on the first floor, with lubricating oil storage and pump room, wash and locker rooms, battery room, radiator core cleaning and heavy storage in the basement. A motor-driven elevator is provided for moving material from one floor to the other.

Facilities outside the shop proper include a washing platform, sand towers serving two tracks, 1,110,000-gal. fuel oil storage and pumping equipment. Figure 1 shows a general view of the building, washing platforms, sand towers and tracks. Electric power for these facilities is furnished from the same distribution lines which supply power to the main building.

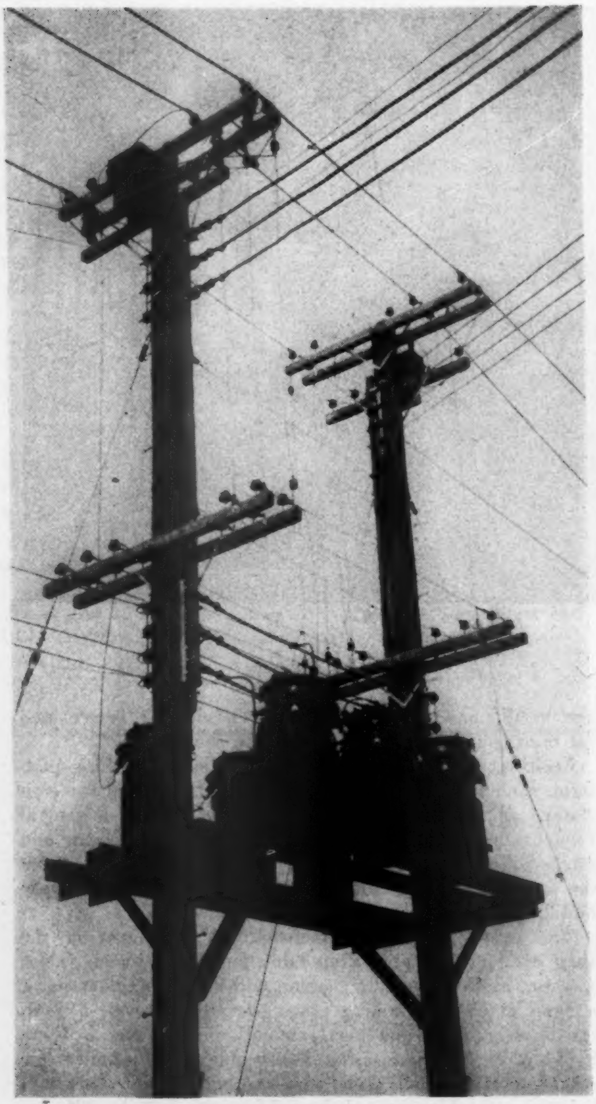
The principal items of motor-driven equipment in the shop itself are a 90-ton drop table for 4 or 6-wheel trucks, a 30-ton overhead traveling crane with 5-ton auxiliary hoist, a 5-ton overhead traveling crane over the lye vat, a 2-ton traveling crane in the parts reconditioning room, a 16-in. by 54-in. engine lathe, as well as a number of smaller machines, portable tools and pumping equipment. This represents a total connected load of approximately 325 hp. The location and capacity of the various motors are shown in a diagram not included with this abstract.

The main items of motor-driven equipment outside the building proper are two 20-hp. motors on Diesel fuel oil pumps, making a total connected load for the new facilities of approximately 365 hp. In view of the nature of Diesel maintenance work, it is not likely that many of the larger machines will be operated at one time. Consequently, the load factor is relatively low.

The voltage on power distribution circuits in the roundhouse and existing installations at Chattanooga, is 440-volt, 3-phase, 60-cycle, and it was decided to utilize the same voltage rating for motor-driven equipment in the new Diesel shop for purposes of standardization.

Unit heaters and exhaust fans with motors of 0.1 hp. or less, were installed with single-phase motors. The larger unit heaters with motors up to 2 hp. and exhaust fans with motors up to 1 hp. are all on the 440-volt, 3-phase circuits.

In order to supply a secondary electric power source to the main shop building and also to the other facilities, an outdoor type substation was constructed. This station includes a bank of three 75-kva., 2400/440-volt transformers and also a bank of three 37.5 kva., 2400/208/120-volt transformers. The bank of three 75-kva. transformers with secondaries connected "Delta" supplies power for the three-phase motor load while the bank of three 37.5 kva. units with



Outdoor substation, including three 75-kva and three 37.5-kva. transformers, which supplies the electric power needs of the Southern's Citico Diesel shop.

secondaries connected "Wye" supplies 4-wire 208/120-volt power for lighting, portable tools and small single-phase motors. These transformers, together with oil switches, breakers and incidental apparatus are mounted on an elevated platform which is supported by two creosoted pine poles. The outdoor substation arrangement is shown in Fig. 2. Power is supplied to the transformers from a railway-owned 2.4-kv. distribution line.

Because the track and building arrangement is such that space is limited, it was necessary to locate the outdoor type substation about 60 ft. from the main shop building. The secondary service wires extend from the top of the poles supporting the transformers to a point near the top of the building, thence through a line of conduit to the main distribution center in the shop. The 3-phase, 440-volt circuit consists of three 350 m.c.m. conductors and the 208/120-volt circuit consists of four No. 1/0 conductors.

Power for operation of motor-driven equipment in the building is distributed through four convertible type panelboards with industrial breakers. A main panelboard acts as a combined service entrance switch and distribution panel. It is located near the center of the building on the inside wall between the shop and the filter cleaning room. This combined entrance and distribution panel consists of a main 600-amp. breaker, together with 12 branch circuits of various capacities for handling some of the large motors and the sub-feeders for six branch circuit panels located at different load centers in the building.

Electrical Facilities in Coach Yards

To develop information regarding the trend among the railroads of the country covering present and proposed precooling installations, a questionnaire was circulated among the voting members of the Electrical Section. Information was obtained covering precooling installations, battery charging facilities and power supply for yard lighting.

Replies received showed that the majority of the newer installations employ 75- and 100-amp. receptacles at a spacing of 75 to 90 ft. for single receptacles and 100 to 170 ft. for double receptacles. Double receptacles with insulated plugs using 4-conductor cords are most generally used. Fused plugs are used by few railroads. Circuit breakers for protection appear to be coming into more general use on the new installations apparently where higher installation cost is justified.

In considering the trend toward the 75- and 100-amp. installations, the plug and receptacle manufacturers have listed material necessary to convert existing 60-amp. equipment to the larger rating. These changes consist mainly of a change in the contacts and bushings to handle the increased current. In some cases, the plug handle must also be changed.

There appears to be some question as to the proper size wire to use with plugs of the various ratings. One manufacturer recommends No. 4 wire for 60-amp. plugs, No. 2 wire for 75-amp. installations, and No. 1 wire for 100-amp. installations. There has been some comment on the weight of the plug and cord assembly when No. 1 wire is used. It is suggested that where actual current requirement does not reach 100 amp., consideration might be given to use of smaller size wire consistent with code requirements for the load actually carried.

Battery Charging Facilities

Of the 53 railroads reporting, 41 have battery charging facilities and 12 have none.

Of the 41 railroads returning data on their battery charging facilities, 15 reported that charging was taken care of through a yard d.c. distribution system, 3 reported charging being provided through portable chargers, supplied from an a.c. distribution system, and 23 used a combination of d.c. distribution system and portable chargers.

The d.c. distribution systems included series systems with voltages varying between 110 and 250; multiple systems having voltages between 32 and 90; and series-multiple systems with voltage variations between 110 and 160. There does not appear to be any standard voltage for the various systems as the voltage appears to be dependent on equipment available and yard servicing conditions.

Portable chargers used vary considerably as to types—various railroads reported the use of converted welders, gasoline and Diesel engine-operated charging sets, copper oxide and rectox units, and motor-generator sets. Newer installations tend toward the installation of alternating current yard receptacles supplemented by portable chargers to provide the direct current requirements.

A summary of data received follows:

Receptacle Capacity Amperes	Number of Railroads
60	4
100	28
150	11
200	3

Receptacle Capacity Ft. Ft.	Number of Railroads
50 to 70	7
75 to 90	16
100 to 120	5
140 to 170	6

Receptacle Type	Number of Railroads
Single	21
Double	6
Both	7

To summarize, the majority of the railroads use receptacles of 100 to 150 amp. capacity. One railroad expresses preference for receptacles rated at 250 amp. A majority reported the use of single receptacles, spaced 80 to 85 ft. apart. The control of circuits is presumably from charging panels in the power supply room in the d.c. yard distribution systems, or from control panels on portable chargers where connection is made to the yard distribution system.

Power Supply for Yard Lighting

Circuits for yard lighting are distributed according to local conditions. Information obtained from the reporting railroads follows:

Method of Carrying Circuits	Number of Railroads
Underground	6
Overhead	23
Both	7
None	15
Direct from power company	2

Location of Lights	Number of Railroads
Floodlight towers	15
Between track	11
Both	10
Side of yard	2
None	15

A number of new installations of precooling and battery charging facilities are reported as being under construction or recently completed. Details are not available for this year's report, but it is hoped to have information on some typical installations for inclusion in subsequent reports. Railroads reporting as having installations under way or completed are as follows:

Railroad	Location
Pennsylvania	Pittsburgh, New York, Philadelphia
Baltimore & Ohio	Grand Central Station and Lincoln St. terminal, Chicago
Louisville & Nashville	Louisville, Ky., Knoxville, Tenn.
Richmond, Fredericksburg & Potomac	Richmond terminal
Chicago, Burlington & Quincy	Chicago coach yard
Canadian Pacific	Winnipeg and Vancouver, Canada
St. Louis-San Francisco	Tulsa, Okla.
Seaboard Air Line	Miami, St. Petersburg and Tallahassee, Fla., Birmingham, Ala., Wilmington, N. C.
Chesapeake & Ohio	Newport News, Va., Louisville, Ky.
Denver & Rio Grande Western	Salt Lake City Union Depot
New York, New Haven & Hartford	Dover Street yard, Boston
Delaware & Hudson	Rouses Point, N. Y.
Atlantic Coast Line	Tampa, Fla.
Delaware, Lackawanna & Western	Hoboken, N. Y., Buffalo, N. Y.
Southern	Birmingham terminal
Norfolk & Western	Roanoke, Va.
Illinois Central	Jackson, Miss., Memphis, Tenn., Chicago
Wabash	Jefferson Ave. coach yard, St. Louis, Mo.
Virginian	Norfolk, Victoria and Roanoke, Va., Princeton, Mullen and Page, W. Va.

The report is signed by C. P. Trueax (*chairman*), assistant electrical engineer, Illinois Central; S. D. Kutner (*vice-chairman*), assistant engineer, New York Central; R. E. Hauss, electrical designer, Cincinnati Union Terminal; R. H. Herman, engineer of shops and equipment, Southern; H. A. Hudson, signal and electrical superintendent, Southern; F. A. Rogers, engineer, electric lighting and distribution, New York, New Haven & Hartford; G. L. Sealey, assistant engineer, Reading; C. S. Stringfellow, assistant to electrical engineer, Atlantic Coast Line; W. D. Taylor, electrical engineer, Canadian National; A. L. Veith, assistant electrical engineer; and Laurence Wylie, electrical engineer, Chicago, Milwaukee, St. Paul & Pacific.

Discussion

The report was presented by Mr. Trueax. J. M. Trissal, superintendent of communications and electrical engineer, Illinois Central, wanted to know what is done with the fourth wire in a portable cable when it is used with an uninsulated plug. L. S. Billau, electrical engineer, Baltimore & Ohio, supplemented this question, saying that in some cases, that while the car is grounded on the rail, this did not provide an effective ground, and there was potential between the car and the wet ground along side the car. Mr. Trueax replied that one manufacturer is making a ground clip for use with portable cables to assure adequate grounding.

J. E. Gardner, electrical engineer, Chicago, Burlington & Quincy, raised a question concerning the standardization of the yard end of plugs and added that many cars now have 25-hp. a.c. motors, and it appears necessary that plug and cable sizes be large enough to handle larger current values. C. A. Williamson, electrical engineer, Texas & New Orleans, said that his railroad uses a 100-amp grounded system. This, he said, is sufficient for today but might not meet all future requirements. Mr. Billau said it has been necessary to keep motors on cars small enough to use existing car connectors.

T. W. Milligan, Pyle-National Company, expressed the opinion that 25-hp. motors should be considered a minimum. A number of roads, he said, are changing from 60- to 75- and 100-amp plugs. The starting current sometimes reaches 200 amp, involving the question of using delayed action fuses in fused plugs. He also said that a ground clip for all insulated plugs is now available. This clip provides a connection with the fourth wire which is closed when the plug is inserted before the power wires make contact. Most railroads, he said, use four-conductor cable for all applications. Mr. Brown suggested that the grounding of circuits in passenger car yards might follow the procedure used in the grounding of circuits on oil sidings. In reply, Mr. Billau said this may be possible in yards, but that much charging is done in terminals where grounds cannot be used because of signal connections. Mr. Brown suggested that they could use impedance bonds in ground circuits to avoid interference with signals. Mr. Gardner said that in his opinion it would be better to stick to four-wire cables because of the wide use of metal handle plugs. Another reason for having good grounds was offered by W. D. Taylor, electrical engineer, Canadian National. He said that current through anti-friction bearings may spot the rollers. Further study of the subject will be made by the committee.

Electrolysis

The report on electrolysis (not included in the bound preprints issued by the Section), deals with the joint committee report on cathodic protection against electrolysis. The joint committee represents those pipe lines, gas lines, water lines, etc., and the reason for the study now being made is that one man's protection may upset that of another. Several bulletins have been prepared and a consolidated bulletin will be issued.

The addendum to the previous reports on electrolytic corrosion of steel in concrete was also presented. This deals with a further investigation of the specimens tested by the committee. On August 10, 1949, the specimens were entirely removed from the ground, and broken up in the presence of the committee, represented by A. E. Archambault, (chairman), assistant engineer, New York Central, J. M. Trissal, superintendent of communications and electrical engineer, Illinois Central, G. M. Magee, research engineer, and R. Ferguson, electrical engineer, research staff of Engineering Division, A. A. R.

Discussion

Dr. L. S. Brown, Portland Cement Association, reported on having examined the specimens. He said that the conclusions in last year's report were still good with certain exceptions. He said that some of the asphalt coating had broken down, showing the need of care in applying the asphalt, particularly to the rod. Stainless steel, he said, had finally corroded as badly as other specimens, the loss of weight being about the same.

Mr. Trissal asked why the concrete deteriorates when encased in steel. Dr. Brown said that this was probably caused by expansion of the electrode, resulting from the formation of sulphate. The concrete, he said, was crushed between the steel case and the expanding inner electrode.

Overhead Transmission Line and Catenary Construction

Under Assignment 1, the committee submitted a proposed Specification for the Joint Use of Poles for Power, Communication and Signal Circuits on Railroad Property, which was prepared in collaboration with representatives of the Communications Section and the Signal Section. This specification has been published by the Communications Section as a separate document.

The specification which is largely based on the latest edition of the National Electrical Safety Code, is submitted with the recommendation that it be approved for submission to letter ballot for inclusion in the Manual as recommended practice, provided it receives similar approval by the Communications and Signal Sections. The Manual of the Electrical Section at one time contained such a specification, but it was deleted because of being obsolete. Inasmuch as the new specification has been printed by the Communications Section and, if approved by the section and its voting representatives will appear in its Manual, it can be covered in the Manual of the Electrical Section by reference only.

The report is signed by K. H. Gordon (*chairman*), assistant electrical engineer, Pennsylvania; A. B. Costic (*vice-chairman*), electrical engineer, Delaware, Lackawanna & Western; E. H. Anson, vice president, Gibbs & Hill, Inc.; R. F. Crump, assistant to electrical engineer, Virginian; E. M. Hastings, Jr., wire crossing engineer, Chesapeake & Ohio; S. W. Law, signal engineer, Northern Pacific; John Leisenring, electrical superintendent, Illinois Terminal; S. R. Negley, electrical engineer, Reading; H. H. Newman, general electrical foreman, Illinois Central; P. E. Snead, chief signal and electrical inspector, Southern; and Sidney Withington, chief electrical engineer.

Discussion

The report was presented by Mr. Gordon. The specifications contained in the report were approved, and will be submitted to letter ballot for adoption in the Manual.

D. M. Burckett, electrical engineer, Boston & Maine, offered an expression of appreciation for the great amount of work done by the committee.

Wire, Low Voltage Cable and Insulating Materials

In accordance with instructions to the committee, specifications for insulated wire and cables have been prepared and are submitted for adoption and publication in the Manual to replace corresponding material now appearing therein.

These specifications cover the requirements for low voltage rubber or synthetic rubber-insulated cables with the common types of covering; braids, lead sheath or non-metallic sheath. Although they do not include all the types of wire described in the specifications now in the Manual, they provide a nucleus to which may be added the bare copper wire, weatherproof, varnished cambric and paper and lead insulated cables which may be required by the Electrical Section.

A further list of specifications covering the above types, will be presented to the Section for letter ballot at the next annual meeting.

The report is signed by C. R. Troop, (*chairman*), assistant engineer, New York Central; G. L. Sealey (*vice-chairman*), assistant engineer, Reading; E. R. Ale, office of electrical engineer, Pennsylvania; L. S. Billau, electrical engineer, Baltimore & Ohio; L. L. Carter, assistant chief engineer, Anaconda Wire & Cable Company; P. W. Pleasant, electrical supervisor and chief fire inspector, Chicago, Indianapolis & Louisville; R. F. Pownall, superintendent of electrical transmission; and C. P. Taylor, electrical engineer, Norfolk & Western.

Discussion

The report was presented by Mr. Troop. It was approved and will be sent to letter ballot for replacing the present material in the Manual.

Motors and Control

The report of the Committee on Motors and Control was prepared jointly by a committee consisting of members of both sections. A summary appears in the foregoing pages with the Electrical Section, Mechanical Division reports. It was discussed separately by the two Electrical Sections.

Discussion

The report was presented to the Electrical Section, Engineering Division, by A. P. Dunn, electrical foreman, New York Central, R. H. Herman, engineer shops and equipment, Southern, and C. F. Steinbrink, general electrical foreman, Chicago, Rock Island & Pacific. It was announced that a description of the Pennsylvania's heavy electrical repair shop will be included in the 1950 report.

K. H. Gordon (P. R. R.) said there is "much gold to be mined" by consolidation of meters. Records compiled by his department showed savings effected by such consolidations have amounted to five times the cost of running the electrical engineer's office.

Electric Heating and Welding

The report of the Committee on Electric Heating and Welding represents an extraordinary amount of committee work, and it is in fact a handbook of information on the subject, which has been prepared specifically for the needs of the railroad users. To permit its being published in full, it will appear in the December issue of *Railway Mechanical Engineer.*

Gas Turbine-Electric Locomotive

During the recess in the afternoon's proceedings, a paper on the Alco-G. E. gas turbine-electric locomotive was presented by J. J. Prendergast. This locomotive was described in the July 1949 issue of *Railway Mechanical Engineer.*

Discussion

The discussion developed that the locomotive has been given extensive tests on the General Electric test track at Erie, that it has been run on the Renovo division of the Pennsylvania, that it was tested on the Nickel Plate between Buffalo and Cleveland, and that it is now in operation on the Union Pacific. Some trouble, it was said, had been experienced from the use of oil containing sludge, but there has been no difficulty on the Union Pacific with industrial type fuel. The locomotive's thermal efficiency is about one-half that of the Diesel-electric locomotive, but the cost per gallon of fuel oil is just about one-half, so that fuel costs of the two should be comparable. Gas temperature to the turbine is 1,320 deg. F. At full load exhaust temperatures reach a maximum of 860 deg. F., and the velocity of the exhaust is approximately 150 m.p.h. Noise produced by the locomotive is a component of noises from the inlet and outlet gases. It is of the same order of magnitude as a steam locomotive with the pop open. It offers some interference in the conversation between the cab and the wayside, but not in the cab, and is not objectionable a short distance from the locomotive. Changes are being made to reduce the noise.

Track and Third Rail Bonds

The last report of this committee was submitted to the Section at its annual meeting on October 22, 1946, and carried a recommendation for the adoption of a Specification for Rail-Head Pin-Type Bonds and Track Connectors.

This recommendation was approved, and the specification (9-C-46) is now included in the Manual of the Electrical Section. This latest specification, together with the Specification for Stud Terminal Copper Rail Bonds (9-a-32) and the one for Welded Type Rail Head U-bonds and Extended Bonds (9-b-43), seem to cover, as far as materials are concerned, all of the types of standard bonds likely to be used on electrified sections of steam railroads.

At the 1947 meeting of the Section, mention was made of certain developments that had taken place in the application of traction bonds by arc welding. The development proved to be a small compact lightweight gasoline-driven welder which could be used for applying the arc-weld type of bond. In its final form it is mounted on two wheels with an outrigger to the other rail, which is quickly demountable by pulling a pin at the welder. The outrigger has a wooden wheel to provide insulation. The rated capacity is 150 amp., and the weight is 340 lb.

A welder of this type is being used by the Chicago, Milwaukee, St. Paul & Pacific in applying No. 4/0 traction bonds. It provides up to 150 amp. for use with a 5⁄32-in. coated rod. Three beads are run, instead of the one bead normally used on a.c. traction circuits. Its real advantage is stated to be its light weight for convenient handling, incidentally providing good control for welding current.

The report is signed by Paul Lebenbaum (*chairman*), electrical engineer, Southern Pacific; A. B. Costic (*vice-chairman*), electrical engineer, Delaware, Lackawanna & Western; W. P. Bovard, Manager, Rail Bond division, Ohio Brass Company; H. H. Febrey, Supervisor Specialty Sales, American Steel & Wire Company; C. G. Lovell, assistant electrical engineer, Chicago, Milwaukee, St. Paul & Pacific; H. G. McMillan, assistant engineer, New York Central; C. R. Wadham, assistant engineer, electrical department, Illinois Central; L. C. Walters, assistant to vice president, Southern; and R. C. Welsh, foreman, office of electrical engineer, Pennsylvania.

Discussion

The report was presented by Paul Lebenbaum (U. P.). There was no discussion, but Mr. Negley (Reading Co.) announced that Mr. Lebenbaum is retiring from railroad service and that this was his last official appearance as chairman of the committee. Mr. Negley extended to him the thanks of the Section for his many contributions to its reports.

Clearances for Third Rail and Overhead Conductors

The report of the Committee on Clearances for Third Rail and Overhead Conductors was not included in the pre-prints made available to members before the meeting. This is a continuing committee, which normally makes no report unless circumstances require. The report was presented by H. F. Brown, electrical engineer, New York, New Haven & Hartford, and it offers small changes to two dimensions in present third rail clearances. The proposals received the approval of the Electrical Section and the report will be referred to the Clearance Committee.

Corrosion Resistant Materials

The Committee on Application of Corrosion Resistant Materials to Railroad Electrical Construction has now completed a symposium of all its reports made since 1930. This report, which is now about to go to the printers, contains the results of extensive studies covering corrosion of a great variety of materials exposed to steam enginehouse gases, to overhead wires suspended over tracks on which steam locomotives are operated and to overhead wires subjected to salt air.

It was suggested that a similar study be made to determine corrosive effect of Diesel fumes.

Illumination

Manual section 10-a-39, Floodlighting Railroad Yards, was published 10 years ago. Due to advances made since that time, this section is susceptible to some slight revision.

The proposed revision is as follows:

The illumination of a yard employing mechanical car retarders differs materially from that of a car rider type yard. The retarders are controlled by operators stationed in towers placed near the retarders, usually along the sides of the main switching area. Illumination in the retarder area must be relatively high, sufficient to enable these operators to compare with their cutting lists, quickly and accurately, the cars as they approach and pass over the retarders, and to estimate their speed.

There must be sufficient illumination in the body of the yard to enable the operators to check, visually, the extent to which each track is occupied, so that the proper amount of retardation may be applied. This requires a higher level of illumination than would suffice for a car rider yard where necessary observation distances are relatively short. Since long range seeing is involved under conditions where rail glint and silhouette are at a minimum value as an aid to vision, light projected from the body of the yard toward the hump and the control towers, as in the parallel-opposed systems, has practically no component of value to compensate for the detrimental masking effect of glare. It is, therefore, recommended that, in retarder yards, unidirectional lighting be used in the body of the yard to as great an extent as is practicable. If some opposing light must be used, the projectors should be so located and trained as to minimize direct glare in the direction of the hump and the control towers.

Ladder tracks must be well lighted to enable the operators to see that all cars clear the switches and do not foul following cars.

Developments in Electric Lighting

Fluorescent Lamps (Type F)

1.—A new, 25-watt, 33-in., T-12 bulb, white lamp is available. It is the longest lamp that can be used on 118-volts without a transformer-type ballast. Any considerable installation would require auxiliary means for power factor correction. Light output is approximately one-half greater than that of a 20-watt, Type F lamp. It is not anticipated that this lamp will be used extensively.

2.—A new 75-watt, 96-in., T-12 slimline lamp is available in white, 4,500-deg., soft white and warm tint.

3.—The light of the so-called "warm tint" lamps blends well with that of filament lamps, being only about 200 deg. Kelvin higher in color rating. These lamps must be used with discretion because too great a preponderance of warm tint over filament light, or the use of warm tint lamps only, is likely to give complexion aids or other decorative effects an appearance much different from that intended, always on the undesirable side. Its effect on the appearance of unretouched human skin is not pleasant.

New Filament Lamps

1—A new 100-watt white lamp has an almost perfectly diffusing bulb which eliminates the "hot spot" observed in clear or inside frosted lamps. Efficiency is substantially equal to that of the inside frosted lamp. It is available also in 100-200-300-watt three-light lamps and is useful in situations where all or part of the lamp bulb falls within the line of vision.

2.—Infrared industrial heating lamps, 375-watt in R-40 bulb, and 500-watt in G-30 bulb may be had.

3.—A 75-watt, R-30, reflector spot and flood lamp has been designed for use in restricted space or where a smaller capacity lamp of this type is desired.

4.—A general service lamp, 75-watt, A-19 bulb has been made possible by the use of the coiled-coil filament. It has the same physical dimensions as the 50 and 60-watt, A-19 lamps.

Safe Disposal of Discarded Fluorescent Lamps

Much trepidation has been caused by alarming, so-called "information," disseminated by radio, the press and other agencies, concerning the lethal hazards inherent in fluorescent lamps. The general public has been led to believe that the Type F lamp is a deadly contraption lying in wait for the destruction of the unwary. It has been implied that it would explode on the slightest pretext, showering the denizens with noxious fumes and poisoned glass slivers. Fatality was indicated.

As a matter of fact, there is no authentic case of an exploded Type F lamp of or any really serious injury due to one. It is true that the phosphors contain a small percentage of beryllium which, if allowed to remain in a cut or sore, delays healing but such trouble as may ensue is entirely local and there is no infection due to it. It does no good to breathe the phosphors or the gas from the lamp, but the probability of injury from this source is remote, unless great quantities of lamps are broken at one time.

In view of the uproar over this matter, and to avoid accusation of negligence, one railroad has put out a safety bulletin modeled on the recommendations of the Medical Advisory Committee on Beryllium, the chairman of which is Dr. J. G. Townsend, medical director of the industrial division of the U. S. Public Health Service. This bulletin, which is presented as information, follows:

The inside of fluorescent lamps is coated with a powder which contains a poisonous substance. In disposing of discarded lamps by breakage, the following precautions should be taken:

1.—Do not breathe any of the powder. It may irritate the breathing organs.

2.—Avoid being cut by glass carrying the powder which, in a wound, will delay healing. Such a wound should be treated at once by a physician. If a physician is not available, thoroughly clean the wound of glass and powder with soap and water, and then apply a standard antiseptic and a sterile bandage.

3.—Do not allow any refuse from the lamp to enter any existing sore or wound.

Lamps should be broken before final disposal to remove their attractiveness to children or other uninstructed persons.

A few lamps may be broken in a waste disposal area without danger, if precautions are taken against flying glass and breathing of the dust.

Greater quantities of lamps, requiring considerable time to handle should be broken up in a waste disposal area big enough, or isolated enough, so that any dust which may arise will settle or be widely dispersed before reaching any inhabited area. In this case, heavy gloves and a respirator must be worn. Care should be taken to prevent accumulation of dust on the clothing.

If breakage in a populated area can not be avoided, it should be done under water and the refuse disposed of by burial or covering in a disposal area.

Do not place lamps, or refuse therefrom, in an incinerator.

The report is signed by E. R. Ale (*chairman*), office of electrical engineer, Pennsylvania; L. S. Billau (*vice-chairman*), electrical engineer, Baltimore & Ohio; V. R. Hasty, electrical engineer, Union Pacific; H. A. Hudson, signal and electrical superintendent, Southern; S. D. Kutner, assistant engineer, New York Central; F. B. McConnel, assistant signal electrical engineer, Pittsburgh & Lake Erie; A. E. McGruer, electrical engineer, Canadian Pacific; G. L. Sealey, assistant engineer, Reading; W. D. Taylor, electrical engineer, Canadian National; and C. A. Williamson, electrical engineer, Texas & New Orleans.

Discussion

The report was presented by E. R. Ale (P. R. R.). W. S. Lacher, secretary of the Electrical Section, announced that previous illumination reports have been most popular and have required more reprinting than any others. Discussion of the report centered about the potential hazards in the scrapping of worn-out fluorescent lamps, and it was made evident that such hazards have been greatly over-rated even when large quantities of lamps are to be broken up. Simple precautions will prevent any injury to workers. It was also stated that Beryllium which has been used as a component of the interior coating, and which has been the reason for discussions on the subject, is no longer used by the manufacturers.

NEWS

Chicago Car Foremen Elect Officers

At the annual meeting of the Car Foremen's Association of Chicago on October 21, the following officers and directors were elected for the year 1949-50: President, W. J. O'Brien, general car foreman, N. Y. C. & St. L., Chicago; first vice-president, E. W. Gebhardt, assistant superintendent car department, C. & N. W., Chicago; second vice-president, Charles T. Graves, assistant chief engineer, Tank Car Division, General American Transportation Corporation, Chicago; secretary-treasurer, J. A. Dingess, mechanical department, Union Tank Car Company, Chicago.

Board of Directors: J. S. Acworth, assistant vice-president, General American Transportation Corporation; E. Buchholts, district general car foreman, C. M., St. P. & P.; R. A. Burke, purchasing agent, Mather Stock Car Company; W. J. Demert, sales representative, Griffin Wheel Company; W. A. Emerson, superintendent car department, E. J. & E.; C. C. Heckart, sales representative, Cardwell Westinghouse Company; H. L. Hewing, superintendent of interchange, Chicago Car Interchange Bureau; F. O. Leffler, vice-president, North American Car Corporation; C. A. Mick, chief clerk, C. B. & Q.; W. N. Messimer, general superintendent equipment, Merchants Despatch Transportation Company; M. J. Mills, assistant superintendent car department, Pere Marquette division, C. & O.; A. R. Nelson, sales representative, W. H. Mincer, Inc.; A. V. Nystrom, superintendent car department, C. R. I. & P.; W. J. Parker, executive vice-president, Iron & Steel Products, Inc.; J. J. Root, Jr., vice-president, Union Tank Car Company; W. C. Shiffer, general foreman, N. Y. C.; C. S. Wagner, M. C. B. bill clerk, G. T. W.; H. J. Weldrake, assistant to superintendent yards, Pullman Company; J. A. Welsch, superintendent of equipment, I. C.

A.S.M.E. Annual Meeting

Cornelius Vanderbilt Whitney, assistant secretary, U. S. Department of Commerce, and Dr. H. J. Gough, president of the Institution of Mechanical Engineers of Great Britain, will be among the speakers at the 1949 annual meeting of the American Society of Mechanical Engineers. Engineering contributions to a peaceful world will be the theme of the meeting which will be held at the Hotel Statler (formerly the Pennsylvania Hotel), New York, November 28 to December 1, inclusive.

Twenty-two professional divisions and committees will participate in 79 technical sessions. Tentatively, the program for the Railroad Division sessions is as follows.

Tuesday, November 29

9:30 a.m.

Gas Turbine II—Railroad I

A 4,000-Hp. Gas-Turbine Locomotive, by W. A. Brecht, manager Transportation Engineering Department; Charles Kerr, Jr., consulting engineer, Transportation Department, and T. J. Putz, manager, Gas Turbine Engineering Department, Westinghouse Electric Corporation.

Gas-Turbine Power Plants in Locomotives, by R. A. Williamson, manager, Railroad Rolling Stock Division, and A. H. Morey, Locomotive Engineering Division, General Electric Company.

Wednesday, November 30

9:30 a.m.

Railroad II—Materials Handling V

Symposium on American Railroads—Our Largest Materials Handling Industry:

Train Operation, a Complex of Materials Handling, by A. E. Perlman, general manager, Denver & Rio Grande Western.

Handling Supplies Used in Railroad Operation, by Carleton W. Meyer, assistant to the president, Chesapeake & Ohio.

2:30 p.m.

Railroad III—Materials Handling VI

Symposium on American Railroads (continued):

Modern Freight-House Design and Operation.

Materials Handling Devices Used in Maintaining Railroad Rolling Stock, by S. H. Hammond, president, Whiting Corporation.

Thursday, December 1

9:30 a.m.

Railroad IV—Management VII

Symposium on Attracting Mechanical Engineering Graduates to the Railroad Industry:

Discussion by:

F. K. Mitchell, manager equipment, New York Central System.

J. B. Akers, chief engineer, Southern System.

D. L. Wallace, counselor on management, Cincinnati, Ohio.

12:15 p.m.

Railroad Division luncheon

2:30 p.m.

Railroad V

Progress in Railway Mechanical Engineering—Report of Committee RR-6 Survey, T. F. Perkinson, manager, transportation engineering division, General Electric Company.

The Talgo Train, by J. M. Gruitch, director, research and development, American Car & Foundry Co.

ORDERS AND INQUIRIES FOR NEW EQUIPMENT PLACED SINCE THE CLOSING OF THE OCTOBER ISSUE

LOCOMOTIVE ORDERS

Road	*No. of locos.*	*Type of loco.*	*Builder*
Baltimore & Ohio	10[1]	1,000-hp. Diesel-elec. switching units	Lima-Hamilton
Chicago, Milwaukee, St. Paul & Pacific	4	1,000-hp. Diesel-elec. switching units	Baldwin Loco.
Cincinnati Union Terminal	2[2]	750-hp. Diesel switching	Lima-Hamilton
Duluth, South Shore & Atlantic	3	1,500-hp. Diesel-elec. road switch units	Baldwin Loco.
	3	2,000-hp. Diesel-elec. transfer units	Baldwin Loco.
Long Island	8[3]	2,000-hp. Diesel-elec. pass.	Fairbanks, Morse

[1] When deliveries, which are scheduled to begin in January, are completed, switching operations on the B. & O. at Dayton, Ohio, and Hamilton will be completely Dieselized.

[2] The 750-hp. switcher, according to Lima-Hamilton, is, as nearly as possible, a duplicate of the company's 1,000-hp. design, with maximum interchangeability of parts between the two models. All dimensions are the same, with the chassis, hood, and truck frames identical. The engine of the new 100-ton locomotive is a six-cylinder version of the eight-cylinder in-line engine used in the 1,000-hp. unit, with 9-in. by 12-in. cylinders, pressure charging, and intercooling of air between compressor and intake manifold. The engine of the 750-hp. switcher is conservatively rated at 900-hp. at 950 rpm. The locomotive develops 750 b.hp. for traction. Electrical equipment of both the 750- and 1,000-hp. units is Westinghouse, and is identical insofar as possible. Starting tractive force at 30 per cent adhesion is 60,000 lbs., and continuous tractive force is 34,000 lb. at 6.1 m.p.h. The 750-hp. switcher is available for multiple-unit operation, including electrically controlled sanding between units, and also with left-hand, as well as right-hand, operation position if desired.

[3] Purchase authorized by the court. Authority has also been received to cancel orders placed with the American Locomotive Company for nine 660-hp. Diesel-electric switching locomotives and order in their place eight 1,000-hp. Diesels, of which four will be used in passenger service and four in road freight service.

NOTES:

Canadian Pacific-Boston & Maine.—Canadian Pacific-Boston & Maine passenger trains between Montreal, Que. and Boston, Mass., will become the first main-line passenger trains in Canada to be powered by Diesel-electric locomotives specially designed for passenger service, when three of the latest type Electro-Motive Diesels are delivered this month, according to N. R. Crump, vice-president of the C.P.R. The three 2,250-hp. locomotives will complete Dieselization of the C.P.R.'s 171-mile run between Montreal and Wells River, Vt. The change-over from steam began last June and there are now 12 1,500-hp. road freight units, five 1,500-hp. road switchers and three 1,000-hp. yard switchers in operation. In addition to other work, the road switchers power local passenger trains between Montreal and Newport, Vt.

Denver & Rio Grande Western.—The D. & R. G. W. has purchased three Vista Dome observation coaches from the Chesapeake & Ohio. The three cars, built by the Budd Company, were—up to the time of their sale—in service between Chicago and Grand Rapids, Mich., on the "Pere Marquettes." They are to be assigned to Rio Grande trains No. 1 and 2, the "Royal Gorge," between Denver, Colo., and Salt Lake City, Utah, before the first of next year.

750 hp now ready!

Our line of diesel switchers has been extended to include a 100-ton locomotive that develops 750 horsepower for traction. Starting tractive effort at 30% adhesion is 60,000 lbs. Continuous tractive effort is 34,000 lbs. at 6.1 mph.

The new switcher is, as nearly as possible, a duplicate of our 1000-hp design —with maximum interchangeability of parts between the two. Chassis, hood and truck frames are identical. Electrical equipment of each is Westinghouse, and traction motors and generator are identical. The engine of the new switcher is a 6-cylinder version of the 8-cylinder in-line engine used in the larger locomotive — with 9″ x 12″ cylinders, pressure charging, and intercooling of air between compressor and intake manifold. The engine itself is conservatively rated 900 hp at 950 rpm.

The new switcher will give a performance that will excel that of other locomotives of its rating. It is available for multiple-unit operation, including electrically controlled sanding between units—and also is available with both right-hand and left-hand operating positions, when this is desired.

Further details will be furnished upon request to the Lima Locomotive Division of the Lima-Hamilton Corporation; Lima, Ohio.

LIMA HAMILTON CORPORATION

C. P. R. Converting Western Locomotives to Oil

ALTHOUGH its only public manifestation to date was a recent announcement of the placing in Winnipeg, Man.-Calgary, Alta., passenger service of a 2800-class "Royal Hudson" locomotive, the Canadian Pacific is making steady progress on its substantial program of converting steam locomotives used on its western lines from coal to oil burners.

The first locomotive to be so converted, a 2300-class G-3-e, was placed in passenger service between Calgary and Edmonton, Alta., last January; by next January a total of 100 conversions will have been completed—78 at Weston shops in Winnipeg and Ogden shops in Calgary and 22 at Angus shops in Montreal, Que. As of September 9 motive power on the C. P. R.'s Prairie and Pacific regions included 710 coal-burning and 190 oil-burning steam locomotives and 49 Diesel-electric locomotives, the latter all being in yard service.

E. G. Bowie, superintendent of motive power and car department at Winnepeg, who is supervising the conversion work, points out that oil-storage facilities are available at Winnipeg, Moose Jaw, Sask., and Calgary.

The conversion work involves removal of grates and application of firepans and of oil tanks made of welded-steel plates and installed in the former coal spaces in the tenders. In the "Royal Hudsons" these tanks have a capacity of 4,600 usable imperial gallons, or 131 barrels, and replace 21 tons of coal.

Eleven locomotives of the "Royal Hudson" class remain to be converted to make all main-line passenger power between Winnipeg and Calgary oil burning. They will operate on extended runs, with only one intermediate fueling in each direction, at Moose Jaw, 398 miles from Winnipeg and 434 miles from Calgary. West of Calgary, to Vancouver, oil-burning motive power includes some of the C. P. R.'s 5900-class "Selkirk" locomotives, said to be the largest in the British Empire; locomotives of this type delivered this year were also said to be the last steam locomotives to be ordered for the Canadian Pacific, which is using an increasing number of Diesels.

Miscellaneous Publications

LABORATORIES FOR RESEARCH AND DEVELOPMENT.—Franklin Institute of the State of Pennsylvania, Philadelphia 3, Pa. 40-page illustrated book. 8½ in. by 11 in. Paper covered. The book shows some of the investigations for which the Franklin Institute Laboratories are equipped and some of its capabilities. A partial list of sponsors of projects names 24 corporations and other institutions. While it does not cover all of the facilities of the laboratories, which are devoted primarily to development and to associated fundamental research in the fields of engineering and the physical sciences, the book does mention in most instances the equipment and experience needed for the particular type of work under discussion.

SUPPLY TRADE NOTES

CLIMAX-MOLYBDENUM COMPANY.—*Vernon H. Patterson*, formerly sales metallurgist of the American Brake Shoe Company, has joined the development staff of the Climax Molybdenum Company, Detroit, Mich.

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UNITED STATES TESTING COMPANY.—The United States Testing Company has expanded its services in the control of welding operations to include the qualification of welders for welding contractors and steel fabricators. This work is being carried out in the Testing Company plant at Hoboken, N. J. The new service permits the employer to send the prospective welder employee to the plant where qualification tests are made and the weldments tested in a continuous operation. Certificates are issued to cover the qualified men. Twenty-four to 48 hours cover the operations.

◆

HUNT-SPILLER MANUFACTURING COMPANY.—*Alonzo J. Edgar*, works manager of the Benton Harbor Malleable Iron Company since 1946, has been appointed general manager of the *Hunt-Spiller Manufacturing Company*, Boston, Mass.

◆

SPRING PACKING CORPORATION.—*Ralph A. Parker* has been appointed eastern sales representative of the Spring Packing Corporation, with offices at 30 Rockefeller Plaza, New York 20. Mr. Parker was formerly engaged in railroad sales for the Ansonia Electrical Corporation, manufacturers of insulated wire and cable. *John R. Sinding* has been appointed eastern sales manager of the corporation, with headquarters at Philadelphia, Pa. Mr. Sinding joined Spring Packing in 1946 as a service engineer at Chicago.

◆

AMERICAN CAR & FOUNDRY CO.—*G. L. Gabrielson* has been appointed sales agent in the Pittsburgh office of the American Car & Foundry Co. Mr. Gabrielson was formerly in the miscellaneous products division, sales department, in New York.

◆

DEARBORN CHEMICAL COMPANY.—*Leo E. Flinn* has been appointed to the sales staff of the Dearborn Chemical Company, Chicago, and will serve as sales representative in the promotion of the company's No-Ox-Id rust preventives in the railroad field.

◆

CINCINNATI ELECTRICAL TOOL COMPANY.—The *Hisey-Wolf Machine Company*, Cincinnati, Ohio, has been acquired by the Cincinnati Electrical Tool Company. The Hisey-Wolf line of industrial grinding machines and buffing and polishing lathes will be continued under the old trade name, but will be manufactured in the plant of the Cincinnati Electrical Tool Company.

LANDIS TOOL COMPANY.—The *C. F. Bulotti Company*, 475 Fourth street, San Francisco, Calif., has been appointed the Landis distributor for northern California and western Nevada. The *Lang Company*, Box 479, Salt Lake City, Utah, has been appointed the Landis distributor for the State of Utah and surrounding sections of Idaho, Wyoming, and Nevada.

◆

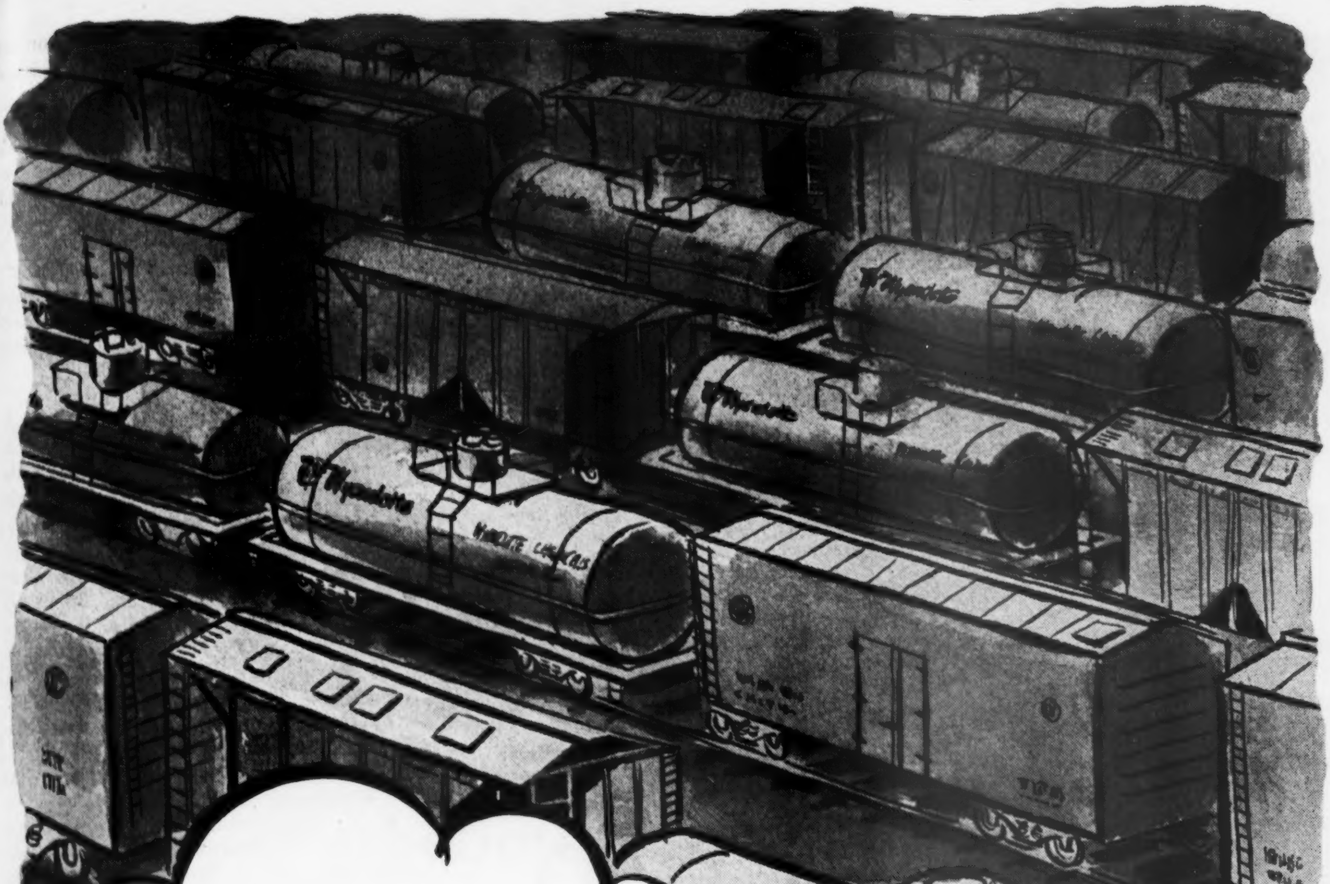
LODGE & SHIPLEY CO.—The Lodge & Shipley Co., Cincinnati, Ohio, has discontinued the manufacture of the Acme line of turret lathes in order to devote its facilities to the development of its extended line of new model X and Duomatic lathes. The company will continue to furnish repair parts and most turret-lathe tooling for the Acme turret lathe.

◆

SPERRY PRODUCTS, INC.—*L. F. A. Mitchell* has been appointed sales manager of Sperry Products, Inc., Danbury, Conn. Mr. Mitchell formerly was manager of headquarters sales of the Crocker-Wheeler Electric Manufacturing Company.

◆

ELLIOTT COMPANY.—The *Elliott Company*, Jeannette, Pa., has acquired the business and assets of the *Crocker-Wheeler division* of the *Joshua Hendy Corporation*. The Crocker-Wheeler division will continue to operate under its previous management with *Charles A.*



A large order? Perhaps so, but it doesn't include a single freight, tank or hopper car that isn't needed. For Wyandotte Chemicals Corporation ships more than *eighty-two carloads of finished products every day.*

The basic ingredients of these products — coal, limestone and salt — all come from company-owned facilities. Control of these sources has contributed much to the high quality of Wyandotte Products. It has assured a steady, dependable supply of raw materials and has helped make Wyandotte the world's largest manufacturer of specialized cleaning compounds for business and industry.

Wyandotte makes the *complete* line of railway cleaners. No matter what your cleaning needs may be, your Wyandotte Representative is ready to supply you with efficient, economical products which are made to fit those needs. He's only a telephone call away.

Wyandotte Chemicals Corporation
Wyandotte, Michigan · Service Representatives in 88 Cities

Wyandotte
REG. U. S. PAT. OFF.

Butcher as general manager. Mr. Butcher also has been elected a vice-president of the Elliott Company.

◆

ULSTER IRON WORKS.—The New York sales office of the Ulster Iron Works has been moved to the company's general offices at Dover, N. J.

◆

D. W. ONAN & SONS, INC.—*John W. Thorp Company,* 50 Church street, New York, have been appointed Onan representatives for railway sales in New York and the New England area.

◆

REYNOLDS METALS COMPANY.—*C. J. Beneke* has been appointed product manager for the wire, rod, bar, structurals and cable division of the Reynolds Metals Company, at Louisville, Ky.

◆

JAMES G. BIDDLE COMPANY.—*D. Robert Yarnell,* president of the James G. Biddle Company since 1944, has been elected chairman of the board and *J. Robert James,* formerly vice-president and treasurer, has been elected president. *Edward H. Wannemacher* has been re-elected vice-president and secretary.

◆

WESTINGHOUSE AIR BRAKE COMPANY.—*W. C. Bryant,* formerly mechanical expert for the southwestern district of the Westinghouse Air Brake Company, at St. Louis, Mo., has been appointed representative in charge of the Houston, Tex., office, succeeding O. W. Swartz, deceased.

Mr. Bryant joined the Westinghouse Air Brake Company in 1946, after serving for six years in the United States Army, where he attained the rank of lieutenant colonel. Mr. Bryant formerly was with the St. Louis-San Francisco and, after completing his machinist apprenticeship course, was identified with maintenance and operation of air brakes.

W. C. Bryant

◆

BALDWIN LOCOMOTIVE WORKS.—The Baldwin Locomotive Works has purchased the press business of the *Defiance Machine Work, Inc.,* Defiance Ohio. The purchase includes all models of Defiance preform presses which will now be manufactured under the Baldwin-Defiance name at the Bald-

win plant at Eddystone, Pa. Original drawings, other engineering data, and accessories for specialized applications are included in the transaction. The presses will be sold through Baldwin district sales office.

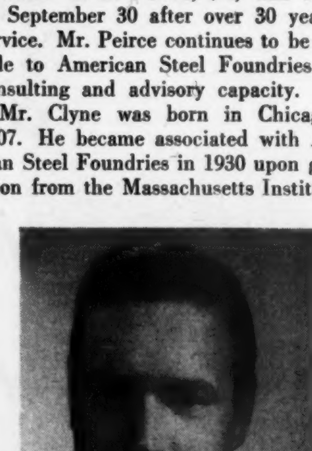
◆

AMERICAN STEEL FOUNDRIES.—*Robert W. Clyne* has been appointed manager of the passenger, locomotive and industrial department, Railway Sales Division, of American Steel Foundries, with headquarters at Chicago. Mr. Clyne succeeds *Armand H. Peycke* who retired on October 1 after 37 years of service. Mr. Peycke, however, will be available in a consulting capacity and for special assignments. *R. W. Dwight, Jr.*, has been appointed sales agent, in charge of the company's southeastern territory,

Robert W. Clyne

with offices at Baltimore, Md. Mr. Dwight succeeds *C. B. Peirce, Jr.*, who retired on September 30 after over 30 years of service. Mr. Peirce continues to be available to American Steel Foundries in a consulting and advisory capacity.

Mr. Clyne was born in Chicago in 1907. He became associated with American Steel Foundries in 1930 upon graduation from the Massachusetts Institute of



R. W. Dwight, Jr.

Technology. He has served, successively, as sales assistant, sales agent, war production engineer, and, since January, 1946, as assistant vice-president. For

three years he represented both American Steel Foundries and the American Society of Mechanical Engineers at the U. S. National Bureau of Standards, Department of Microscopy and Structure of Metals. In his new position, Mr. Clyne will devote his attention to locomotive and passenger equipment, as well as to industrial springs and forgings.

Mr. Dwight was born in Chattanooga, Tenn., in 1916 and is a graduate in mechanical engineering of Purdue University. He became associated with American Steel Foundries in 1940, and has been active practically all of this period in the sales division—at Chicago, St. Louis, Mo., and, since 1946, in Baltimore as an assistant to Mr. Peirce.

◆

TEXAS COMPANY.—*Albert D. Prendergast,* lubrication engineer and assistant division manager of the Texas Company at St. Paul, Minn., has retired.

YOUNGSTOWN SHEET & TUBE CO.—*Robert J. Mullahy,* district sales manager in charge of the Detroit, Mich., office of the Youngstown Sheet & Tube Co., has retired and has been succeeded by *C. Hix Jones,* formerly assistant district manager.

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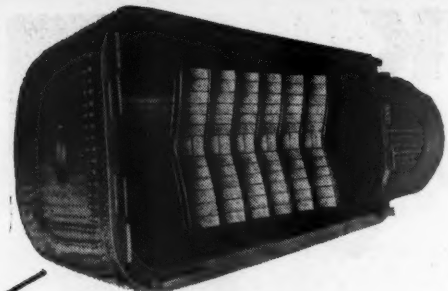
VANADIUM CORPORATION OF AMERICA.—*Gustav Laub,* formerly assistant vice-president and general manager of sales, of the Vanadium Corporation of America, has been elected vice-president in charge of sales.

Gustav Laub

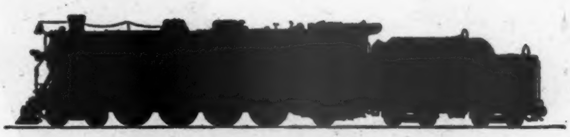
◆

PYLE-NATIONAL COMPANY, MULTI-VENT DIVISION.—The *Multi-Vent Division* of the *Pyle-National Company* has appointed 10 additional manufacturer's representatives, placing sales of that division on a national basis. The new representatives are: *J. P. Ashcraft Company,* 2826 Fondren drive, Dallas, Tex.; *R. M. Brand Company,* Tucson, Ariz.; *Joseph P. Maguire,* 615 Commercial place, New Orleans, La.; *E. H. Norton,* 616 Lloyd Building, Seattle, Wash.; *Pacific Scientific Company,* 1430 Grande Vista avenue, Los Angeles, Calif.; *J. Arch Colbrunn,*



Security Circulators

in use on



50 RAILROADS

After years of experience in designing and furnishing arch brick for both coal-burning and oil-burning steam locomotives, the American Arch Company introduced the Security Circulator, primarily as a support for the brick.

Road service, however, soon showed that Security Circulators also greatly improve the performance of a locomotive and reduce maintenance cost on both flues and arches.

Since then installations of thousands of Security Circulators have been made by fifty railroads in twenty-five different types of locomotives. These installations have definitely stepped up the earning ability of the locomotives, through increased efficiency of operation and greater availability.

* * *

Recently the American Arch Company has also developed the Security Dutch Oven to increase the efficiency of combustion in oil-burning steam motive power.

American Arch Company Inc.

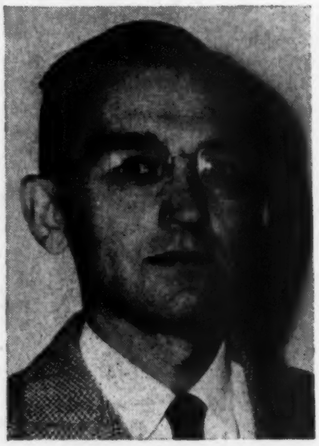
NEW YORK • CHICAGO

1605 McLemore avenue, Memphis, Tenn.; *Franc s J. Fallquist*, 507 Kuhn building, Spokane, Wash.; *Thomas E. Price*, 11 Oak Court, Houston, Tex.; *Northwest Furnace Supply Company*, 911 Northwest Hoyt street, Portland, Ore.; and *S. C. Pardee*, Sharon building, San Francisco, Calif.

◆

Electric Storage Battery Company.—*C. J. Moore*, formerly manager, Pittsburgh, Pa., branch of the Electric Storage Battery Company, has been appointed manager of Exide's railway and motive power sales division. *C. H. Leet*, formerly a salesman in the industrial battery department of the Pittsburgh branch, has been appointed manager of the branch.

Mr. Moore joined the company in 1935



C. J. Moore

as a salesman in the industrial department at Pittsburgh. From 1942 to 1946, he was supervisor of motive-power sales and, in the latter year, was transferred back to the Pittsburgh branch as assistant manager and shortly after he was appointed manager.

◆

Westinghouse Electric Corporation.—*Walter J. Maytham, Jr.*, formerly manager of the industrial division of the Westinghouse Electric Corporation, has been appointed Pacific Coast district manager, with headquarters at San Francisco, Calif., succeeding *Charles A. Dostal*, vice-president, who will retire in 1950.

C. H. Bartlett has been appointed sales manager for the Westinghouse Transformer Division at Sharon, Pa., succeeding *W. W. Sproul* who has been appointed sales manager of industrial products for the entire company. *Frank L. Snyder* has been appointed manager of the Transformer Division. *E. C. Whitney* has been appointed manager of the Large Salient-Pole generator section of the A-C engineering department of the Transportation and Generator Division.

◆

Greenfield Tap & Die Corp.—The Greenfield Tap & Die Corp. is removing its Ampco twist-drill manufacturing facilities from Jackson, Mich., to Greenfield, Mass. The corporate structure of the Ampco Twist Drill Corporation has been

dissolved and all assets transferred to Greenfield, where a complete drill-making establishment is being set up. *Frank J. Sikorovsky*, president and general manager of Ampco Twist Drill, has been appointed a vice-president of Greenfield Tap & Die. The Ampco sales organization will continue as an independent unit, also with headquarters in Greenfield.

◆

MIDVALE COMPANY. — The following changes have been made in the sales organization and personnel of the Midvale Company: *H. C. Lackey*, with headquarters in the Railway Exchange building, Chicago, has been appointed district sales manager there, with jurisdiction over the St. Louis, Mo., and Houston, Tex., districts; *J. R. Steele* has been appointed representative in St. Louis, with headquarters in the Shell Oil building; and *W. L. Van Winkle* has been appointed representative in Houston, with headquarters in the Second National Bank building. The jurisdiction of *A. R. Gaus*, district sales manager, Pittsburgh, Pa., has been extended to cover the Cleveland, Ohio, district. He will be assisted by *J. W. Baer* and *F. N. Satter*, the latter with headquarters in the Terminal Tower building, Cleveland. *A. Richter*, formerly salesman in the New York district, has been transferred to Washington, D. C., where the office will be continued in the Hill building under the supervision of *R. H. Romig*. A Midvale office has been opened in the Rice building, Boston, Mass., where *Herman Bergholtz* will continue as representative under the supervision of *A. H. Stewart*, New York district manager.

◆

KOPPERS COMPANY.—*T. H. Cable* has become a member of Koppers sales department, Central staff.

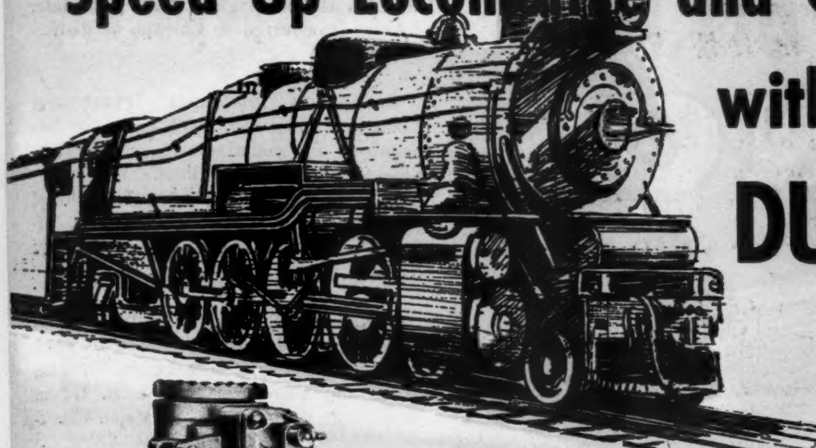
M. A. Hamrick, Chicago district manager for the Wood Preserving division of Koppers Company since 1945, has been

M. A. Hamrick

appointed manager of sales methods at the company's Pittsburgh (Pa.) divisional headquarters.

Mr. Hamrick received a B.A. degree from Oglethorpe University. After graduation he spent one year as football coach at Southern Georgia A. & M. College, and in 1926 joined the Southern Wood Preserving Company. He became associ-

Speed Up Locomotive and Car Repair Work with dependable DUFF-NORTON JACKS



FOR LIFTING HEAVIEST LOCOMOTIVES WITH EASE... *air motor power jacks*

Heaviest locomotives and cars can be lifted with effortless ease with Duff-Norton Air Motor Power Jacks. They save time and energy of workmen—keep them fresh for repair work. Using a "Y" connection, two of these jacks can be operated simultaneously to lift locomotives —including Diesel—evenly and rapidly.

No. 126-RX

Write for Bulletin AD-11

No.2850

FOR REPAIRING EMPTY OR LOADED FREIGHT CARS... *governor-controlled jacks*

The governor-controlled jack greatly facilitates repair work on empty or loaded cars. A mechanical jack with all the operating advantages of a hydraulic jack. Self-lowering mechanism has fingertip control. Jack can be lowered a fraction of an inch without danger of creepage. Load remains at desired height indefinitely.

No. 5010-C-2

Write for catalog and data on your jack requirements.

FOR INSPECTING AND RENEWING JOURNAL BRASSES... *low height journal jacks*

Ideal for inspecting and renewing journal brasses, this jack can be used for many heavy lifting jobs, where load is low and a powerful jack is required. The jack illustrated is of 50-ton capacity, but can be supplied in 25 or 35-ton capacity if desired.

Write for Catalog 203 for data on Complete Line of Jacks.

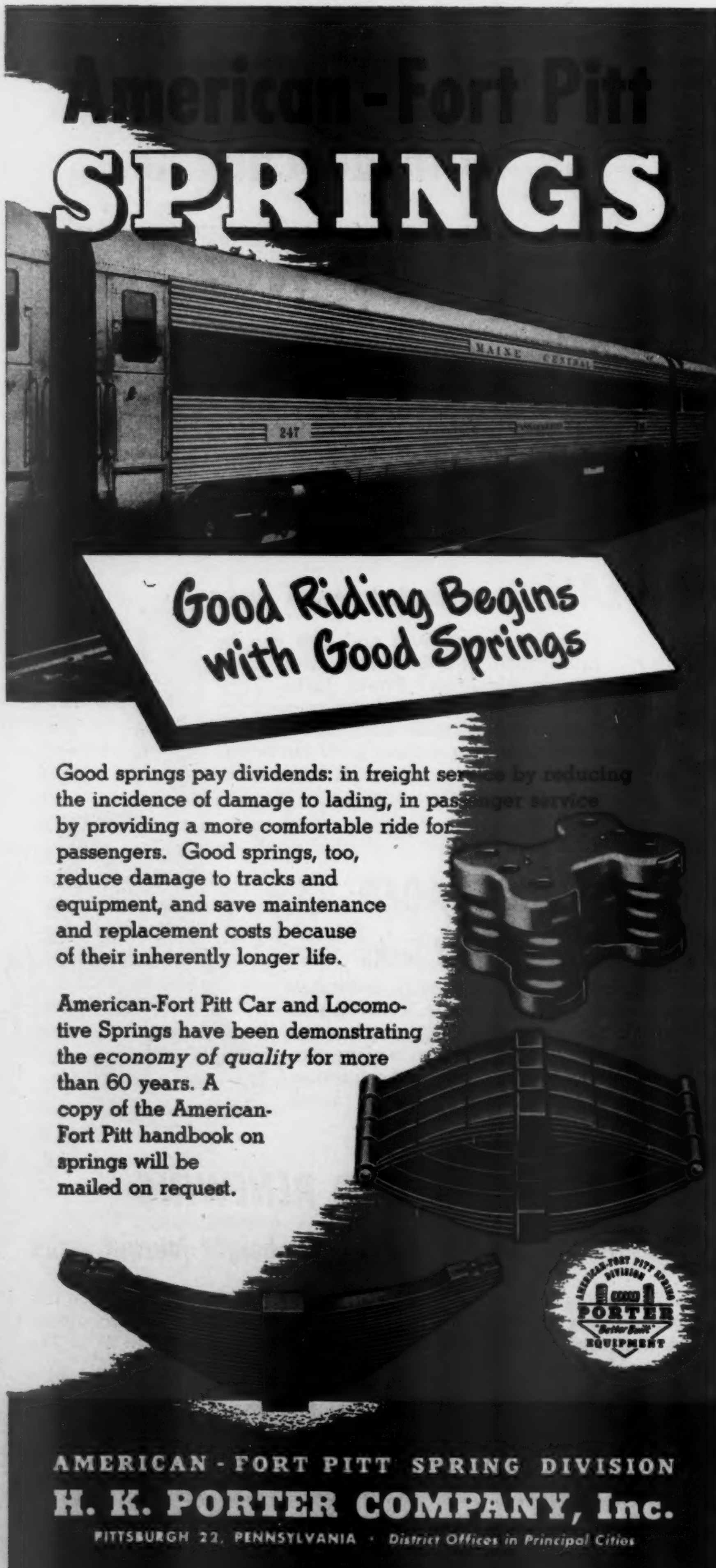
STRENGTH, SAFETY, DURABILITY
DUFF-NORTON JACKS
ESTABLISHED 1883

The DUFF-NORTON Manufacturing Co.

MAIN PLANT and GENERAL OFFICES, PITTSBURGH-30, PENNSYLVANIA—CANADIAN PLANT, TORONTO, ONTARIO

"The House that Jacks Built"

THE WORLD'S OLDEST AND LARGEST MANUFACTURER OF LIFTING JACKS



ated with Koppers in 1928 at the Charleston wood preserving plant, and in 1941 was appointed district manager for the division at Houston, Tex. Four years later he was transferred to Chicago as district manager.

◆

BACHARACH INDUSTRIAL INSTRUMENT COMPANY.—The Bacharach Company has acquired all manufacturing assets and patent rights for the nozzle tester formerly manufactured by Aircraft & Diesel Equipment Corp. Bacharach is also offering complete repair service for all ADECO testers now in use.

◆

VAPOR HEATING CORPORATION.—*T. A. Stewart, Jr.*, has been appointed to work with railroads in Washington, Oregon, Idaho and Vancouver Island, B. C., in connection with the use of Vapor-Clarkson steam generators and train heating controls. Mr. Stewart was with the Atchison, Topeka & Santa Fe for 12 years before joining Vapor Heating.

T. A. Stewart, Jr.

◆

CORNING GLASS WORKS.—The *Corning Glass Works* has established two new departments—lamp sales and electronic sales—to handle sales activities of the electrical products division. *Thomas S. Wood*, associated with the company for the past 20 years and in electrical product sales since 1941, has been appointed manager of the lamp sales department, and *John S. Muller*, a member of the technical products sales staff since 1941, has been appointed manager of the electronic sales department. Organizational changes have also been made in the sales staff of the technical products division. *William H. Tomb, Jr.*, in addition to his present duties as manager of specialty products section of the division, has assumed the position of manager of the appliance parts department of this section, to replace Mr. Muller; *John P. Hoxie*, formerly senior sales engineer, has been appointed product manager of railroad and industrial sales; *Robert W. Jani*, formerly sales engineer, appointed service manager of railroad and industrial sales; *J. Donald Pisula*, formerly senior sales engineer, railroad and industrial sales, appointed project sales

engineer, specialty products sales; *Daniel J. Lammon*, formerly Central district sales engineer, standard products section, appointed senior sales engineer, appliance parts sales, and *Robert L. Callard*, formerly senior sales engineer, railroad and industrial sales, appointed assistant manager of plant equipment sales.

◆

WATSON-STILLMAN COMPANY.—*Frank G. Helander*, formerly midwest sales manager of the hydraulic machinery division of the Watson-Stillman Company, with headquarters at Chicago, has been appointed executive vice-president.

Frank G. Helander

◆

BULLARD COMPANY.—*H. Edward Neale* has been appointed Chicago direct representative of the Bullard Company, working in conjunction with Marshall & Huschart Machinery Co., 571 Washington boulevard at Jefferson street, Chicago.

M. K. Peck has been appointed to supervise and activate sales of the recently acquired Bullard-Universal horizontal boring machine line.

Mr. Peck, a graduate of Lehigh University in 1934, was formerly connected with William Sellers & Co., from 1935 to 1947 as an assistant in sales with duties also of service engineering. In the latter year, when the Consolidated Machine Tool Corporation of Rochester, N. Y., absorbed the Sellers Company, Mr. Peck was transferred to Rochester.

◆

FAIRBANKS, MORSE & CO.—This company has opened a Diesel locomotive sales and service office for the Cleveland (Ohio) area, at its branch house, 2810 Superior avenue. *C. A. Mapp* has been appointed district sales representative, and *H. D. Buckner* has become area service supervisor for Diesel locomotives.

T. E. Woodruff, formerly manager of the St. Louis, Mo., branch house pump department, has been appointed assistant manager of the pump sales division, with headquarters in Chicago.

non H. Patterson, formerly sales metal-

D. C. Prescott has been appointed to the locomotive sales staff of Fairbanks, Morse & Co., in the Chicago district. For the past four years Mr. Prescott has been associated with the sales department of the Baldwin Locomotive Works in the Chicago area.


Hy-Draulic
Rockford Hy-Draulic Duplicators can be set up these four different ways.
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When parts have shapes that standard machines can't produce economically . . . a Rockford Hy-Draulic Duplicator is often the answer. When you equip a Rockford Hy-Draulic 36" Openside Shaper, Planer or Shaper-Planer with a Rockford Hy-Draulic Duplicator such work as machining die or mold contours or producing parts like impeller blades becomes easier to do . . . with accuracy and considerably lower cost.
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1. with stationary template mounted on the rail
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3. with stationary template and generating table fixture
4. with traveling template and generating fixture
CONTOUR WORK MACHINED WITH EASE • ACCURACY • SPEED

DETREX CORPORATION.—The *Detrex Corporation*, Detroit, Mich., has appointed *E. H. Ehlert* as regional manager of industrial cleaning equipment and chemical sales for Midwestern states, with headquarters in Chicago.

◆

COMMERCIAL FILTERS CORPORATION.—The Commercial Filters Corporation, Boston, Mass., has opened a mid-western sales office at 603 West Washington blvd., Chicago 6, with *W. H. Magee*, formerly with the United States Gauge Company, as district manager.

◆

PRECO INCORPORATED.—Preco Incorporated has removed its offices and factory to a new plant at 6300 East Slauson avenue, Los Angeles 22, Calif.

◆

EQUIPMENT RESEARCH CORPORATION.—The *Mount Royal Specialties Company*, Sun Life building, Montreal, Que., has been appointed exclusive distributor in Canada for Mines Equipment Company products; Baffle-Air system of air distribution; hand lantern battery testers, and Safeguard Electric Company's lamp guards.

◆

PAXTON-MITCHELL COMPANY; PAXTON DIESEL ENGINEERING COMPANY.—*Robert R. King* has been appointed Chicago and mid-western representative for the Paxton-Mitchell Company and the Paxton Diesel Engineering Company, Omaha, Neb.

Mr. King received his degree in engineering from Iowa State College in 1943, and during World War II served in the field artillery as a captain. After the war he was employed by the Paxton-Mitchell Company in the engineering and foundry departments, and was later appointed manager of Sensation Engines, a subsidiary of the Paxton-Mitchell Company.

◆

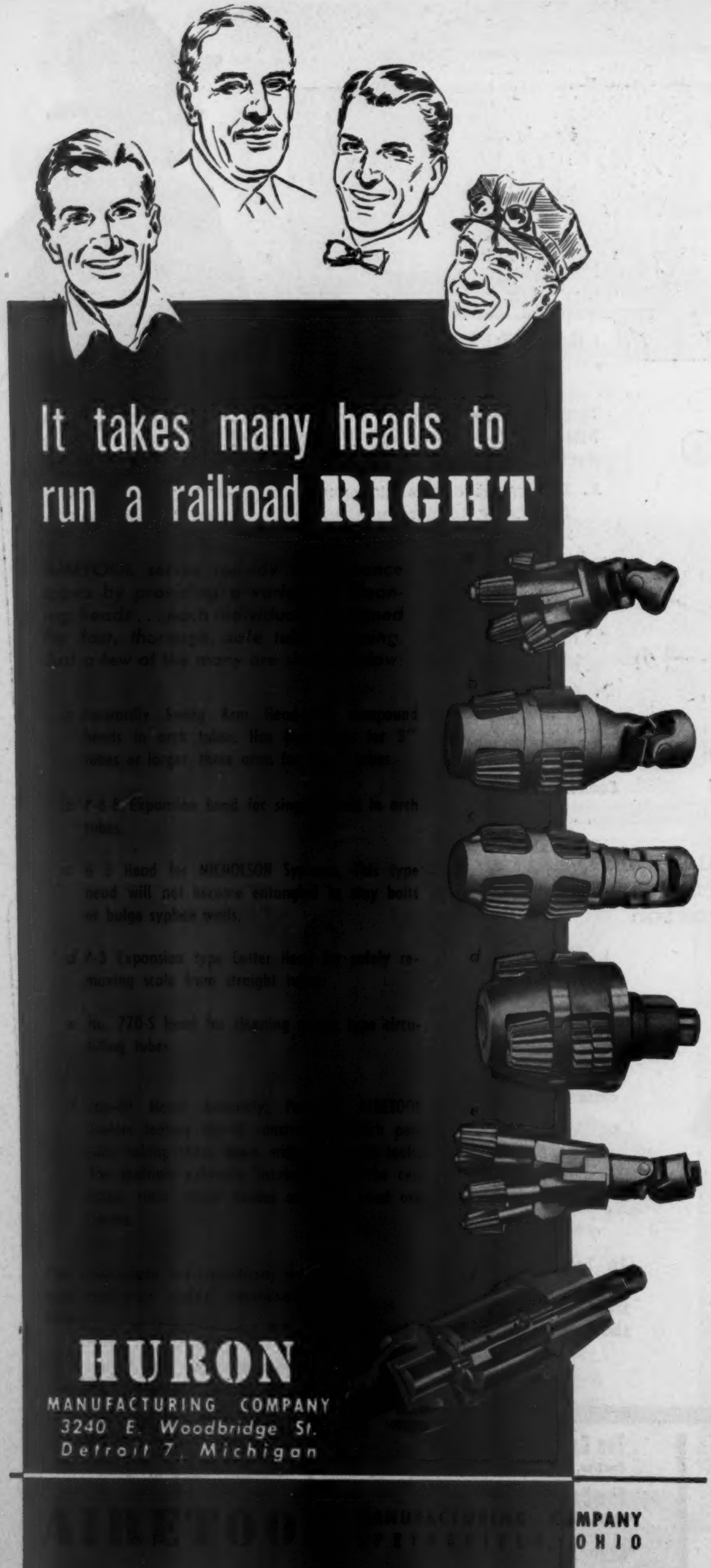
LIMA-HAMILTON CORPORATION. — The *St. Louis Railway Supply Company*, 2114 North Second street, St. Louis, Mo., has been appointed sales agent for Lima-Hamilton products in the St. Louis area. *Henry Vogel*, 4506 Wentworth avenue, Baltimore, Md., has been appointed sales representative in the Baltimore territory, to handle Diesel and steam locomotives and parts therefor.

◆

IRON & STEEL PRODUCTS CO.—*J. J. Collins*, assistant general manager of Iron & Steel Products, Inc., Chicago, has been appointed general manager at Chicago. Mr. Collins joined Iron & Steel in 1948, after having served as superintendent of scrap and reclamation for the Erie at Meadville, Pa.

Obituary

GEORGE R. YORK, a salesman for the Bullard Company at Chicago, died on September 25. Mr. York was born in Monticello, N. Y., on August 10, 1912. He was a graduate of the Monticello high school. He worked at various jobs and subsequently became a machine operator in the employ of the Heppenstall Company. On January 4, 1937, he became a boring mill operator for the



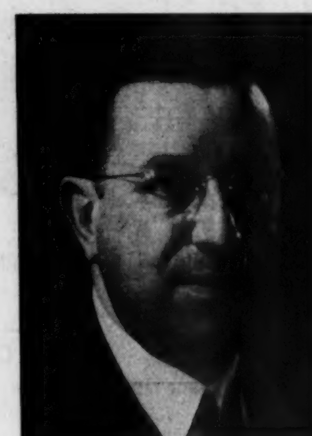
Bullard Company and shortly after was appointed demonstrator. He was transferred to the Chicago office in 1942 as sales engineer.

◆

O W. SWARTZ, representative in the Houston, Tex., office of the Westinghouse Air Brake Company, died recently. Mr. Swartz joined the company in 1919 and was appointed mechanical expert in the St. Louis, Mo., office in 1923. In 1930 he was appointed representative at Dallas, Tex., and, in 1937, was transferred to Houston.

◆

FREDERICK C. KOCH, vice-president and director of Simmons-Boardman Publishing Corporation and business manager of Railway Signaling and Communications, one of its railway publications, died on October 17, at the Mary Immaculate Hospital, Jamaica, N. Y. Mr. Koch was born in Jersey City, N. J. on June 9, 1893. He began his business career with the Railway Age Gazette (now Railway Age) in 1909, and worked successively as copy runner, office boy, clerk in the subscription mailing department, clerk in the circulation department, manager of the advertising makeup department, and assistant to vice-president. In 1917, he was appointed advertising sales representative for all Simmons-Boardman transportation publications. Eight years later he was appointed business manager of Railway Engineering and Maintenance, another Simmons-Boardman publication. He was elected a vice-president of Simmons-Boardman in 1936, a director in 1937 and business manager of Railway Signaling and Communications in 1944.



F. C. Koch

◆

WILLIAM RHOSLYN CUNNICK, vice-president and general sales manager of the Great Lakes Steel Corporation (a subsidiary of National Steel) at Detroit, Mich., died on September 18 at Dearborn, Mich. Mr. Cunnick was born at Niles, Ohio, on April 13, 1892. He started his career as a laborer in the steel mills in 1914 and subsequently served with the Weirton Steel Company as assistant sales manager, and as district sales manager at Detroit where he remained for 12 years, and as assistant vice-president in charge of sales.

Mr. Cunnick became vice-president and general sales manager of Great Lakes Steel only this year.

◆

SHERMAN MILLER, retired vice-president of the American Locomotive Company, died on September 24 at his home in Schenectady, N. Y., after a long illness.

◆

JAMES L. REESE, district manager of the Pyle-National Company at Baltimore, Md., died in that city on August 28. Mr. Reese, who was born on August 9, 1889, at Ducktown, Tenn., had been employed by Pyle-National since 1918. He had previously served with the Central of Georgia and the Louisville & Nashville.

PERSONAL MENTION

EARL S. FARLEY, whose appointment as superintendent of motive power, second mechanical district, Chicago, Rock Island & Pacific, with headquarters at El Reno, Okla., was reported in the October issue, was born in Missouri on June 19, 1891. He attended the public schools at Trenton, Mo., and entered railroad service in 1908 as a laborer, later serving as a machinist apprentice at Horton, Kan. After completing his apprenticeship, Mr. Farley was employed on various roads as a machinist, and subsequently became a machinist on the Rock Island. He was later promoted to enginehouse foreman, which post he held successively at various points on the system, including Trenton, Cedar Rapids, Iowa, and Chicago, until his appointment as general foreman at Goodland, Kan. Mr. Farley subsequently served as general foreman at Chicago and El Reno, and in August, 1947, became master mechanic at Chicago.

FRANK L. KARTHEISER has been appointed assistant to president of the Chicago, Burlington & Quincy at Chicago. Mr. Kartheiser was born at Aurora, Ill., on April 19, 1893, and was graduated from high school in 1910. From 1912 to 1914, he studied engineering and subsequently attended the United States Naval Reserve Officers Training School at Pelham Bay, N. Y., as an ensign. He first entered railroad service with the Burlington in 1909 as a timekeeper at Aurora. In 1917 he joined the United States Naval Reserve Forces and two

Frank L. Kartheiser

years later became employed by the United States Railroad Administration, Central Western region. In 1920 he re-entered Burlington service, was promoted to chief clerk in the mechanical department, and subsequently became assistant to vice-president—operations at Chicago. Mr. Kartheiser is a member of the Car Foremen's Association of Chicago, of which he was president in 1933-34, and the Car Department Officers' Association, of which he was secretary-treasurer from 1937 to 1942. He is now a member of the general committee of the latter association.

GERALD P. TRACHTA, general superintendent of motive power of the Chicago, Rock Island & Pacific, at Chicago, has retired after 48 years of service. Mr. Trachta was born at Schuyler, Neb., on October 5, 1883, and began his career in December, 1901, as an enginehouse sweeper on the Chicago, Burlington & Quincy at Sheridan, Wyo. He later served, successively, as machinist helper and machinist, locomotive fireman and locomotive engineman. In 1910 he became road foreman of engines on the Sheridan divi-

sion, and in 1917 master mechanic, Casper division. Between 1919 and 1923, he was road foreman of engines on the

Gerald P. Trachta

Arizona Eastern (now part of the Southern Pacific) at Phoenix, Ariz. He subsequently returned to the Burlington as enginehouse foreman at Wymore, Neb., and was later transferred to Kansas City, Mo., as general foreman. After serving as master mechanic successively at Omaha, Neb., Galesburg, Ill., and St. Joseph, Mo., from 1925 to 1937, Mr. Trachta became district superintendent of motive power of the Chicago, Rock Island & Pacific at Kansas City, with jurisdiction over the Chicago, Rock Island, Cedar Rapids, Des Moines, Western, and a portion of the Missouri-Kansas divisions. He was appointed superintendent of motive power in 1939, assistant chief operating officer, with jurisdiction over the mechanical department, in 1940, and general superintendent of motive power in July, 1942.

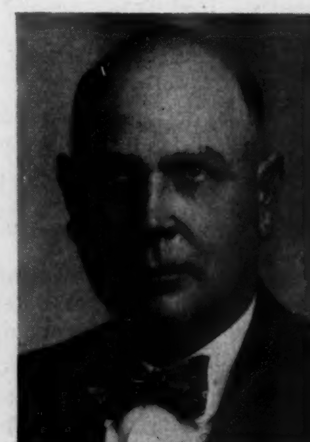
Car Department

A. V. Nystrom, assistant to the general superintendent of motive power, Chicago, Rock Island & Pacific, has been appointed superintendent of the car department, with headquarters as before at Chicago. A photograph and biographical sketch of Mr. Nystrom appeared in the September issue in connection with his appointment as assistant to the general superintendent of motive power.

Diesel

William A. Langlands, whose retirement as superintendent of Diesel and motor car equipment, Chicago & North Western, at Chicago, was reported in the October issue, was born on August 22, 1884, in Chicago. He studied drafting and advanced arithmetic at the Y. M. C. A. night school, and in July, 1899, entered North Western service as a rivet heater in the boiler shop. After completing his apprenticeship in 1904, he became a machinist for the North Western, and later a machinist in the employ of the Illinois Central, Woods Automobile Company, the Buda Company, Harvey, Ill., and the Gates Iron Works. In 1907 he rejoined the North Western as a machinist, becoming assistant enginehouse foreman at Chicago in 1920. He was transferred to North Fond du Lac, Wis., in 1922, as division foreman, Northern Wisconsin division, and from 1923 to 1925, was assistant master mechanic at North Fond du Lac. He subsequently returned to Chicago as general foreman; in 1926 was appointed master mechanic, Chicago Terminal division, and in March, 1944, superintendent of Diesel and motor car equipment.

J. Orville Fraker, whose appointment as electrical engineer and Diesel supervisor of the Texas & Pacific at Dallas, Tex., was reported in the October issue, was born at Orbisonia, Pa., on January 14, 1899. He attended high school in his home town, and Bucknell Academy, Lewisburg, Pa., and in 1920 obtained a degree in electrical engineering from Bucknell University. He began his career in 1917 as an instrumentman with the East Broad Top Railroad & Coal Co. at Orbisonia, and from 1920 to 1922, served as a draftsman with the Pennsylvania at



J. Orville Fraker

Pitcairn, Pa. He subsequently became employed by the Pennsylvania highway department as highway inspector and engineer. In January, 1923, he joined the T. & P. as an electrician at Marshall, Tex., being appointed electrician foreman at that point in April, 1923. Mr. Fraker was transferred to Dallas in 1937 as electrical engineer in the mechanical superintendent's office, and became general electrical and shop engineer there in July, 1946.

Shop and Enginehouse

James A. Coffman has been promoted to the position of foreman pipe and tin shop of the Southern at Chattanooga, Tenn.